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EDITORIAL

A PAPER in this issue, by Cleland and Rackow, is devoted to the radiology of post-operative states arising from the surgery of the chest. This is a subject on which there are few collected records. For although examples are now profuse the literature has remained scattered, and available accounts and discussions are still mainly found to be adherent to exhaustive descriptions of operative details or buried beneath more important statistics of ultimate results. Between the two the technical business of the post-operative course, especially its radiological definition and sequence, is apt to remain in an obscure corner and to escape a fair share of notice.

Cleland and Rackow's paper does a good deal to bring a better light to bear upon the subject. From experience largely at a chest unit where every type of chest surgery is done they have collected together a representative series of radiographs taken in the post-operative phases, and have given a systematic description both of the normal and abnormal appearances that may be encountered after operations of different types.

Rightly, to begin with, they emphasise how obscure the post-operative course will so often remain without the help of skilled radiography. Physical examination is restricted by a variety of circumstances; and even where it is not there are often fallacies that invalidate its conclusions. Thus radiology and a thorough knowledge of what it can show are technical necessities of the first order for the proper care and management of the post-operative phase.

After citing a number of matters important to the radiological technique, they describe the use of opaque media for determining the size, position and shape of pleural and pulmonary cavities, including a new formula suitable as an alternative to iodised oils. Experience with this has been satisfactory, and its wider use now seems to be justified as a small wartime economy.

They turn then to consider the post-operative phase in chest surgery, adopting the logical classification of operations upon the chest wall, the pleura and the lung as the three important types. After the former the chief abnormality is hæmatoma, and tangential views may be needed to distinguish this from a hæmothorax. If the pleura has been transgressed, as in dealing with tumours, there may well be either air or blood in the pleural space as well, remaining undetected but for the help radiology affords. Recognising the presence of fluid levels and the position of the mediastinum are two main requirements after extrapleural pneumonolysis, and detecting of clot in the extrapleural space is another for which a lateral view is much more distinctive

than any other. In dealing with thoracoplasty they point out that the three important complications which may affect the extrafascial space—effusion, hæmorrhage and infection—all lead to distension of the space in a characteristic way.

Dealing with the effects of pleural operations they are necessarily concerned with empyema in the main; and there is emphasis upon recognised essentials rather than upon recent fresh material in a field already better covered in a post-operative sense than the others which they describe. Yet it is a field which even today cannot be traversed by those with experience without feeling that much of what to them must seem elementary has not yet become a part of common knowledge in the way it should. There is no problem in the wide range of thoracic disease more frequently complicated by technical mistakes in management, as all who have to treat the chronic empyema can testify. Fresh accounts of the correct radiological supervision are not redundant: they are very necessary if the doctrines upon which it is founded are to achieve general acceptance.

Lobectomy and pneumonectomy are taken to illustrate the post-operative features of operations on the lung. With the former the condition of the remaining lobe and with the latter of the remaining lung is pre-eminent, and with both the state of the pleural cavity is hardly less significant. Later, in judging such complications as hæmoptysis and residual or recrudescent sputum or pyrexia, bronchography is essential: it delineates the stump, outlines pleural pockets or remaining bronchiectasis and reveals the site and character of fistulæ.

The collective review given in this paper is a timely and valuable one, full of technical detail and sound description. It ought to gain a merited place in the literature of its subject.

C. H.

GENERAL ARTICLES

RADIOLOGY IN POST-OPERATIVE CHEST SURGERY

By W. P. CLELAND and A. M. RACKOW.
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The thoracic complications of surgery are common and troublesome conditions. They are apt to cause special difficulties when they arise as a result of surgery upon the chest itself. Here we are concerned with the diagnosis of these particular forms; and it is not hard to see why the problems which arise should often lead to uncertainties and miscalculations. The patients are usually ill enough to restrict easy and complete physical examination; and the presence of dressings or tubes, and of the fallacies introduced by the effects of trauma to the chest wall, make the elicitation and interpretation of clinical signs matters fraught with the risk of error. Sometimes, as with surgical emphysema, they may invalidate any opinion at all upon the state of affairs in the lungs or pleural cavities which is based solely upon physical examination. Such difficulties are now well recognised, and their common occurrence throws an added responsibility upon radiography for the correct management of these patients.

We propose in this paper to outline certain technical peculiarities and special investigations involved, and to consider briefly the radiological features after certain typical operative procedures, in the normal as well as in the complicated case.

Radiological Techniques

True postero-anterior (or antero-posterior) and lateral radiographs are essential. The importance of the former lies in the fact that minor variations in position of the intra-thoracic structures have, after operation, considerable significance. Surgical procedures frequently obscure or modify the usual bony landmarks, and unless the surgeon has foreknowledge that the patient is not rotated, he has difficulty in assessing the true state of affairs.

The lateral view follows the generally accepted radiological principle of taking two views at right angles. The single P.A. view which suffices commonly in routine chest radiology is quite inadequate for revealing all the information required after operation, though it may be enough to elicit some specific point (Figs. 1-3).

Generally the penetration must be greater than that used in routine work on the chest, and it is of the order of 75-85 K.V. In many cases where large masses of tissue or fluid are present relative to aerated lung, or for lesions obscured by the heart shadow, a Bucky or stationary grid should be used (Figs. 1-3). This increases contrast and differentiates dense shadows. Un-

fortunately, these cases have often to be X-rayed with a mobile or portable unit. The restricted output of these machines makes the use of a grid impossible, especially with lateral views, when breathing is distressed and shortness of exposure is thus imperative. The intelligent radiographer will use discretion in effecting a compromise. Some indication of the state of affairs likely to be encountered is then of value to the radiographer and avoids waste of films and time.

The standard teleradiograph distance of 5 ft. (sometimes 6 ft.) is used and a note should be made in all cases where this is reduced. The central ray from the tube should always be *horizontal*. This point needs stressing, for only if this is so will fluid levels be clearly shown. Many patients are not readily brought into the erect position and recline slightly, so that the film is not truly vertical. This causes slight modifications in the appearance of the chest; for instance, the ribs become more horizontal, but if the tube is directed horizontally fluid levels will still be shown. In the case of the lateral view, it is usually easier to arrange for ray and film to be at right-angles.

The difficulties of restricted power often make it necessary to take the lateral film from a distance shorter than 5 ft. In such cases a truer projection of the basal region of the chest and a better appreciation of diaphragmatic level will be given by centring the tube at the tenth instead of the sixth dorsal vertebra. Thus it is sometimes worth taking two laterals at different levels.

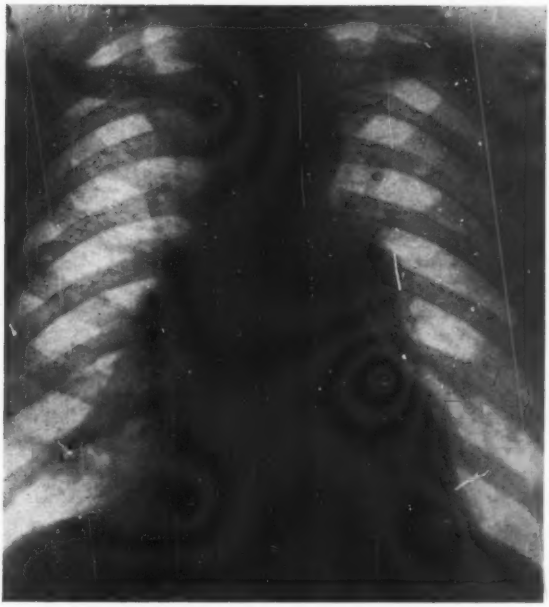
The Use of Opaque Media

The visualisation of body cavities by the injection of opaque media is a general principle which has much application in chest work. Bronchography is now an everyday procedure, and although it assumes an important place in the later assessment of cases we do not propose to discuss its technique here.

Another field of usefulness for iodised oil lies in the delineation of pleural (pleurogram) or pulmonary (cavernogram) cavities which are being drained surgically. The application of these investigations will be considered later, when their extreme importance will be emphasised. *Technique :* The patient lies upon the sound side with the sinus uppermost. The drainage tube is withdrawn, and oil injected slowly through a soft rubber catheter inserted into the sinus until either the cavity is filled or about 20 c.c. have been injected. During injection it is essential to ensure that air, displaced by the oil, can escape freely through the sinus. An opaque rubber strip corresponding in length and position to the original drainage tube is then inserted, after which the sinus opening is tightly plugged with gauze. The patient is then placed supine or prone, as circumstances dictate, and an A.P. (or P.A.) film taken with adequate penetration. He is then placed vertically, sitting or standing, and a lateral view taken, the affected side being nearer the film. These two views are, in routine cases, an effective simplification of the more elaborate procedure, which would entail a minimum of five films taken with horizontal projection, the patient lying on each side in turn.

The information provided by the technique described consists of the general form of the cavity and its upward extent from the horizontal film, and from the erect film the lower limit of the cavity and its relation to the drainage tube.

PLATE XI.



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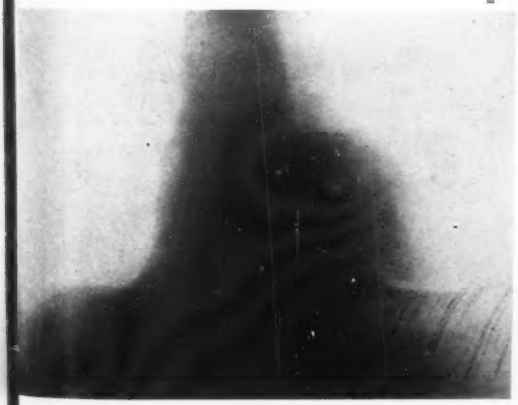

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FIGS. 1-3.—VALUE OF PENETRATING AND LATERAL RADIOGRAPHS.

Shrapnel wound 1941; cough and purulent sputum developed April, 1942. Fig. 1, P.A. view with average penetration reveals little abnormal. Fig. 2, Penetrating P.A. view reveals rounded opacity behind heart with metallic F.B. below it. Fig. 3, Left lateral view shows rounded opacity lying posteriorly with F.B. below it. An encysted empyema containing F.B. was drained.

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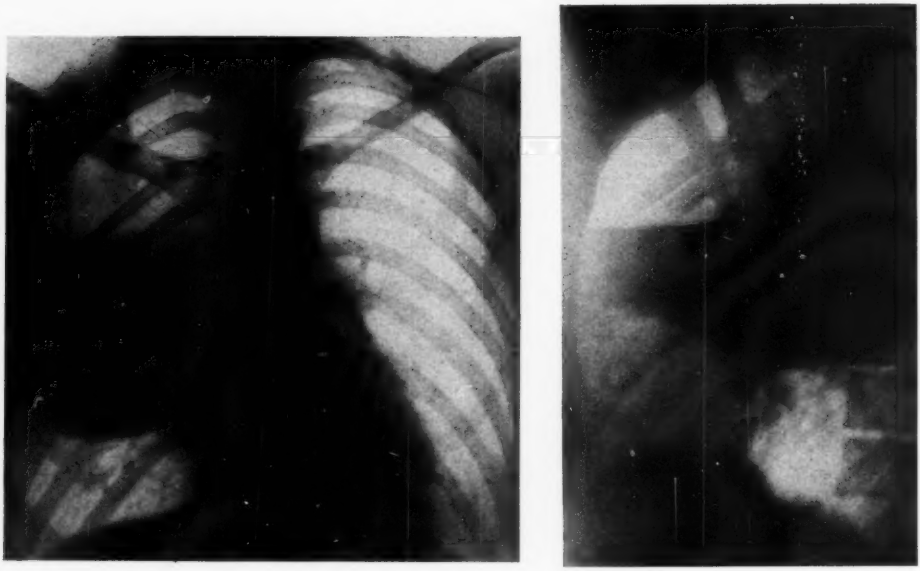

FIGS. 4-5.—CLOTTING IN EXTRA-PLEURAL PNEUMOTHORAX.

Extra-pleural pneumonolysis for right apical tuberculous cavity. Fig. 4, A.P., and Fig. 5, Right lateral radiographs. Clotted blood lying posteriorly with fluid blood forming new level in front when patient sits up for radiography.

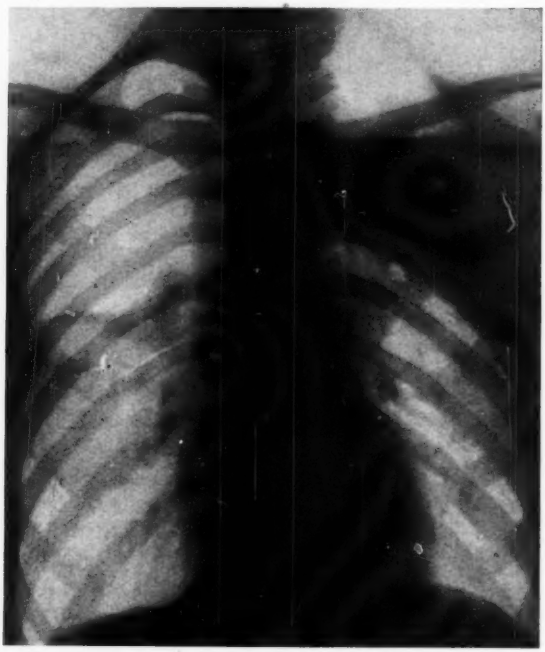

FIG. 6.—NORMAL EXTRA-FASCIAL THORACOPLASTY.

Pulmonary tuberculosis for 4 years. Medium-sized cavity at left apex and right artificial pneumothorax. A.P. radiograph a few days after left upper thoracoplasty with extra-fascial mobilisation showing normal appearance of extra-fascial space.

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When iodised oil has been unobtainable we have used suspensions of barium for pleurography and cavernography, reserving stocks of the former for bronchographs. Where there is no broncho-pleural fistula a suspension of similar consistence to iodised oil is used; where, however, there is a fistula we have recently employed a thick suspension which does not readily enter the bronchial tree. This thick suspension is rather more difficult to handle than the normal as it will only just pour, but the prevention of spilling over into the bronchial tree has been an important gain. So far we have observed no ill effect from its use and the suspension appears to be readily and rapidly discharged through the tube.

The following briefly outlines the method of preparation:

NORMAL VISCOSITY (EQUIVALENT TO VISCOUS NEO-HYDRIOL)

Barium sulphate	50 parts.
Arachis oil to	100 parts.

THICK (CONSISTENCE OF A VERY THICK CREAM)

Barium sulphate	50 parts.
Arachis oil and liquid paraffin equal parts to	100 parts.

Sift the barium sulphate through muslin and mix to a smooth paste with about three-quarters of the oil. Add sufficient oil to produce the required volume and mix thoroughly. Transfer to one ounce, screw-capped, wide-mouthed bottles, leaving a large air space to allow for expansion during sterilisation. Sterilise by heating in a hot air oven for one hour at 150° C.

The viscosity may be increased for any particular strength by passing through an homogeniser or by increasing the proportion of liquid paraffin.

Classification of Operations

Operative procedures in the thorax can for convenience be divided into three main groups:

1. Chest wall operations.
2. Pleural operations.
3. Pulmonary operations.

This simple classification is chosen since each group presents certain distinct radiological features and a study of these three covers a majority of cases. In each group we intend to describe the features of the normal and complicated courses of a few standard operations. The principles discussed are applicable in general to other operations.

1. OPERATIONS ON THE CHEST WALL

(*a*) *Tumours* of the chest wall vary considerably in size and it is often impossible to remove them without transgressing the parietal pleura. Frequently, therefore, the post-operative picture is complicated by the presence of air or blood, or both air and blood in the pleural cavity. It is also not uncommon for a large hæmatoma to arise in the chest wall at the site of the tumour. This may readily simulate a hæmothorax radiologically. The diffuse shadow seen in the face view can readily be shown to be an intramural collection when tangential radiographs are taken.

(*b*) *Extra-pleural Pneumonolysis.*—The radiological appearances and variations, after extra-pleural pneumonolysis, are mainly concerned with the extent of fluid levels and with the position of the mediastinum. Clotting in the extra-pleural space (Figs. 4-5), however, may produce at first sight a confusing picture. After operation the patient lies propped on back rest and pillows at an angle approximately midway between horizontal and vertical planes. Should blood and serum collect and clot, the flat upper level will not lie parallel to the X-rays when the patient sits up for radiography, but at an angle of 45° to them in the A.P. view; the main mass will not, therefore, show a level in this view, though any residual fluid blood may show a smaller secondary level. In the lateral view, however, the upper plane of the clot will be seen as a straight line passing upwards and backwards in the posterior aspect of the chest with fluid blood exhibiting a horizontal line in front.

(*c*) *Thoracoplasty.*—The addition of mobilisation of the apex in the Semb thoracoplasty to the rib resection of lateral thoracoplasty has added the complications of effusion, infection and hæmorrhage into the extra-fascial space (originally occupied by the lung apex) to those of atelectasis, pneumothorax and spread of tuberculous disease. In the normal uncomplicated Semb thoracoplasty, blood and serum collect in the extra-fascial space causing this to appear radiologically (Fig. 6) as a triangular area of translucency in the apical region with its base a horizontal line about 4 inches in length representing the level of the fluid in the cavity. The lateral wall, which is composed of chest wall structures, is normally straight or slightly convex outwards in the early stages. Below the fluid level the homogeneous opacity representing fluid and debris in the extra-fascial space gradually merges into normal lung in the mid-zone.

The three important complications affecting the extra-fascial space (effusion, infection and hæmorrhage) all lead to an appearance of ballooning (Fig. 7). With increase of fluid, the air above is compressed, and, bulging the lateral wall outwards, is often driven up into the tissue planes of the neck. The space, however, may become partly or wholly filled by clotted blood; no fluid level will be seen in such cases.

Atelectasis (Fig. 8) appears as a homogeneous dense opacity with displacement of the mediastinum towards the affected side. Almost without exception it appears on the affected side and usually involves the whole lung rather than an isolated lobe. With adequate treatment the majority resolve and subsequent X-rays show the lung re-aerating. The spread of tuberculous disease in an atelectatic lobe can only be detected when there is some degree of re-expansion.

Pneumothorax differs little from that seen in non-surgical states, but is usually accompanied by pulmonary atelectasis; when the normal features of the extra-fascial space are not present, and a large fluid level is seen at the base, the presumption is that the pneumothorax was accidentally produced at the time of operation and that the extra-fascial contents have passed into the pleural cavity. The complication of a true spontaneous pneumothorax, however, will usually show little or no fluid at the base and the extra-fascial space will present the normal radiological features.

FIG. 7.—BALLOONING OF EXTRA-FASCIAL SPACE.

Pulmonary tuberculosis for 9 months. Right extra-fascial thoracoplasty performed for small cavity at right apex. A.P. radiograph after upper stage, showing large collection of clotted blood in extra-fascial space with air driven upwards into neck tissues and extension downwards almost to diaphragmatic level.

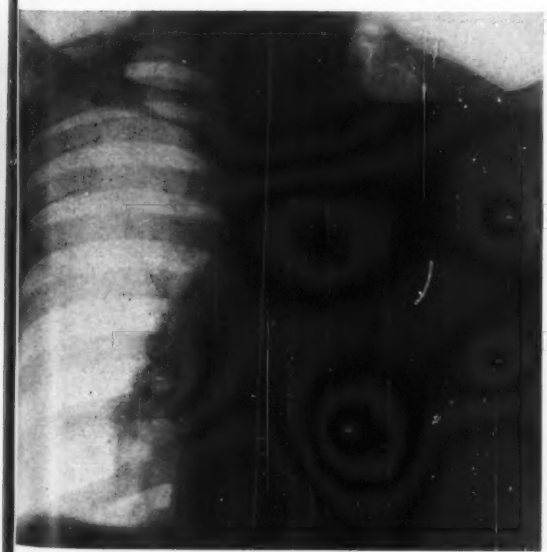

FIG. 8.—TOTAL ATELECTASIS AFTER THORACOPLASTY.

Unilateral pulmonary tuberculosis for 2 years. A.P. radiograph after upper-stage thoracoplasty, showing normal extra-fascial space with total atelectasis of underlying lung.

FIG. 9.—IODISED OIL OUTLINING EMPYEMA CAVITY.

Left lateral radiograph after injection of 20 c.c. iodised oil into empyema cavity, showing floor of the cavity outlined by oil with pus forming fluid level above.

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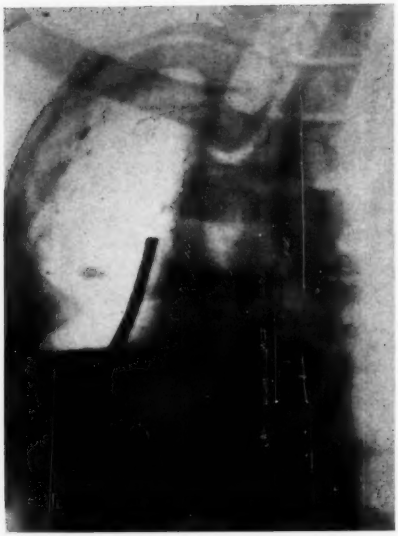

FIGS. 10-11.—NORMAL PLEUROGRAM.

Empyema following pneumonectomy. Fig. 10, P.A., and Fig. 11, Right lateral radiographs in erect position showing base of empyema containing oil whilst a strip of leaded rubber outlines position and length of tube; in this case it is obviously too long to permit free drainage.

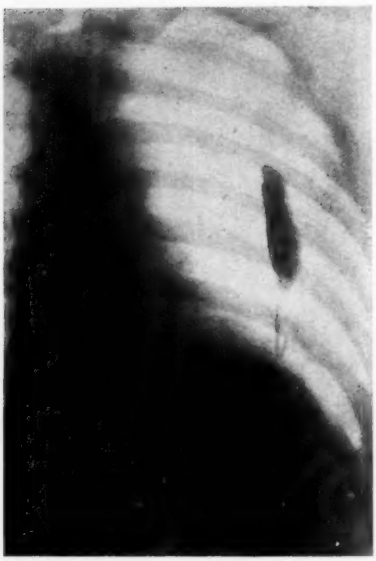

FIG. 12.—HOUR-GLASS PLEUROGRAM.

Post-pneumonic empyema. Pleurogram reveals two pockets connected by a very narrow neck. Re-operation required as it was not possible to pass tube into distal pocket.

FIG. 13.—T-SHAPED PLEUROGRAM.

Empyema due to actinomycosis. Pleurogram shows tube passing beyond mouth of cavity. This region is narrowed and in time it would shut off main cavity from drainage tube. Tube was subsequently manipulated into main cavity.

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2. Operations on the Pleura

The control of pleural fluids and the management of tubes draining the pleural cavity are of fundamental importance to almost every aspect of chest surgery. Success or failure in many a surgical enterprise will depend on the correct management of the pleural factor. The study of empyemata occupies a great deal of the thoracic surgeon's time, and it will, therefore, be of advantage to consider the question in some detail.

In determining the site for aspiration, accurate radiographic localisation is essential. In general the empyema is seen as a diffuse opacity in the antero-posterior view, through which it should be readily possible to see the anterior and posterior aspect of the ribs. By counting these, an anterior and posterior surface marking can be determined, and a line joining these points represents the horizontal plane of the empyema. Study of the lateral view should indicate whether the main mass of the empyema lies in the posterior, middle or anterior plane. The optimum point for exploration will naturally lie where these two planes intersect. A second and less reliable mode of localisation consists in counting the ribs in the lateral film to discover more directly the correct intercostal space for exploration. The disadvantage of this method is the difficulty of counting ribs in the lateral view, especially as those of the right and left side are superimposed. They cannot be distinguished for certain by their sharpness and magnification. Since, as a general principle, the site of drainage of an empyema is placed at or near its lowermost limit, the definition of this limit is of extreme value. The injection of 15-20 c.c. of opaque oil into the empyema, followed by radiography in the erect position (Fig. 9), should provide all the necessary information.

The management of an empyema after drainage has recently been described by Barrett (1942) in this Journal. Efficient tube drainage is required until the pleural cavity has become completely obliterated. Radiographic control is essential for the maintenance of efficient drainage and for assessing the size of the residual pleural space (by pleurogram). For efficient drainage the tube should be placed towards the lower limit of the cavity. It should not be so long that much fluid could accumulate before overflowing down the tube, yet must be long enough to lie securely in the pleural cavity. At the same time, care should be taken that the end of the tube does not impinge upon any vital structure such as lung tissue or pericardium which it might erode. The use of opaque tubing greatly facilitates this control; a simple rubber tube may not be visible on the radiograph when it is surrounded by a region of density. The introduction of opaque oil into the empyema (Figs. 10-11) plays an essential part in the control of drainage and is the most reliable method available for determining when the pleural space is obliterated and when the tube can be removed with safety. The technique of pleurography has already been described in detail. By using leaded rubber, or similar opaque material, to represent the length and position of the tube, an accurate impression of the latter in its relation to the cavity can be obtained. Necessary adjustments can then be made to ensure efficient drainage. The mode of obliteration of an empyema cavity was discussed fully by Barrett in his paper. He pointed out the frequency of irregular obliteration, especially common after war wounds.

In some cases the lower lobe expands more rapidly than the upper and the empyema obliterates from below upwards. In such cases the tube must be lengthened to keep pace with the obliteration and to ensure adequate drainage. In other cases the lung, during expansion, tends to shut off an anterior pocket, producing a cavity like an inverted U, necessitating separate drainage of each pocket. Again, irregular obliteration may produce a waist-like constriction (Fig. 12), with the shutting off of a distal pocket. In these cases the tube should be lengthened and made to pass beyond the constriction in order to maintain the patency of the track until the distal pocket has obliterated. Finally, the tube may pass into a cul-de-sac, whilst the main cavity opens, often through a narrow neck, into the track some distance from the blind end. This forms the so-called T-shaped cavity (Fig. 13), and it is necessary to manipulate the tube into the main track before the neck closes and the main cavity becomes shut off from the drainage tube. If it is impossible to achieve this, re-operation will be necessary.

3. Operations on the Lung

For the purpose of radiological description the appearances after lobectomy and pneumonectomy will serve as typical examples of this group. The features described will be largely applicable to the others, which include wedge resection and the removal of foreign bodies from the lung. The drainage of a lung abscess does not, as a rule, present special radiological problems.

(*a*) *Lobectomy.*—The attentions of the surgeon after lobectomy are mainly directed towards the remaining lobe and the pleural cavity. In the uncomplicated case the remaining lobe should be aerated and fully expanded after operation, whilst a homogeneous opacity of greater or less extent is seen in the region of the removed lobe due to formation of clot and fibrin in the residual cavity. Whether or not tube drainage is employed, a fluid level is usually present. In the former case, this is usually because the tube has been deliberately placed above the lowermost limit of the cavity, to allow for the expected diaphragmatic rise. Where no drainage is employed, a fluid level will be present unless extensive clotting has occurred, or there has been complete expulsion of the air at the time of operation.

Atelectasis of the remaining lobe is a frequent complication and one of some importance, as early and efficient treatment is required to prevent the unfortunate sequelæ of suppuration or bronchiectasis, which carry with them a high morbidity and mortality. Atelectasis, if it occurs, does so usually between thirty-six and seventy-two hours after operation, although it may occur later. The radiological appearances are modified by the presence or absence of adhesions between the layers of the pleura over the lobe concerned. When there are no adhesions (Fig. 14) the lobe is seen as a homogeneous opacity, clearly defined when accompanied by a pneumothorax, but more difficult to identify in the presence of much effusion. If the lobe is adherent, but incompletely so (Figs. 15-16), the lung is stretched between such points of adherence and the hilum, whilst pockets of air occupy the remaining space. If adhesions are complete (Fig. 17), the mediastinum of necessity will be deviated towards the side of the atelectatic lobe and no pneumothorax will be seen.

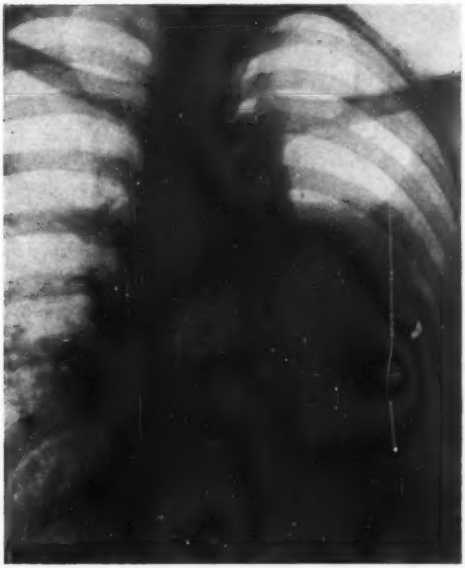
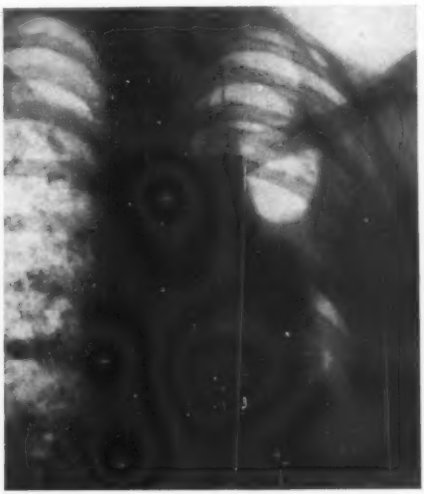


FIG. 14.—LOBECTOMY: UPPER LOBE ATELECTASIS IN THE ABSENCE OF ADHESIONS.

Left lower lobectomy for bronchiectasis. No pre-existing pleural adhesions. A.P. radiograph showing atelectatic upper lobe lying in mid and lower zones and projecting into total pneumothorax. Mediastinum is displaced to left.



FIGS. 15-16.—LOBECTOMY: UPPER LOBE ATELECTASIS WITH PARTIAL PLEURAL ADHESIONS.

Left lower lobectomy for bronchiectasis. Fig. 15, A.P. radiograph immediately after operation, showing aerated upper lobe adherent to lateral chest wall with pneumothorax on its medial side. Opaque band in mid zone represents hilar structures. Fig. 16 shows appearance a few days later with upper lobe atelectatic, appearing like a mushroom plastered on lateral chest wall. Mediastinal structures are displaced towards the left.

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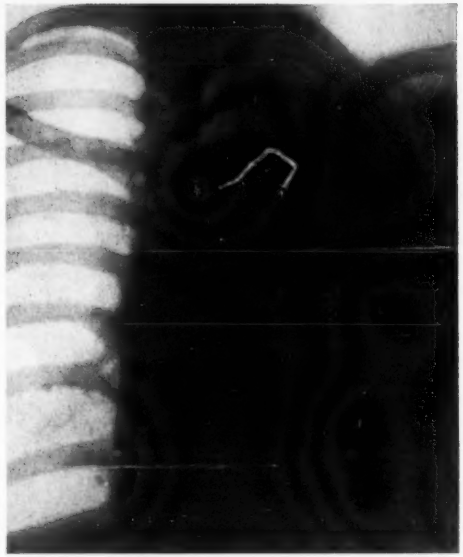

FIG. 17.—LOBECTOMY: UPPER LOBE ATELECTASIS IN THE PRESENCE OF UNIVERSAL PLEURAL ADHESIONS.

Left lower lobectomy for bronchiectasis. A.P. radiograph 1 week after lobectomy, showing airless upper lobe, no pneumothorax and displacement of mediastinum towards left side.

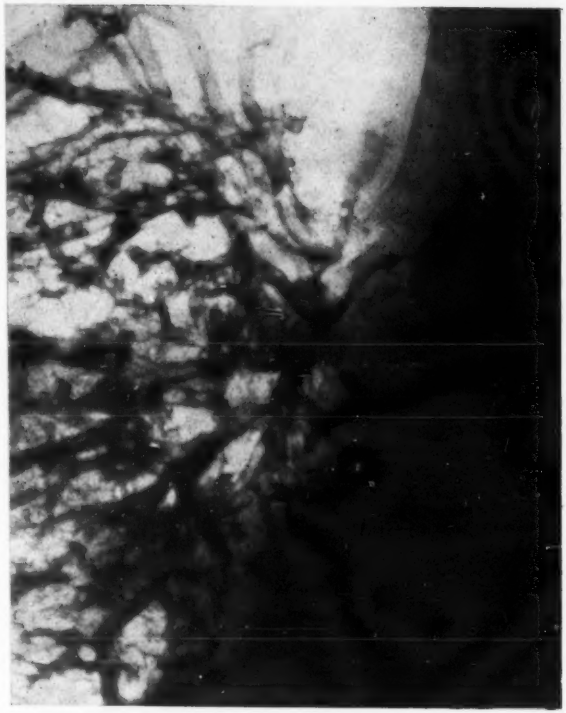

FIG. 18.—LOBECTOMY: NORMAL STUMP.

Right middle and lower dissection lobectomy. Right bronchogram (contact print) 3 months after operation shows small smooth stump of main descending bronchus.

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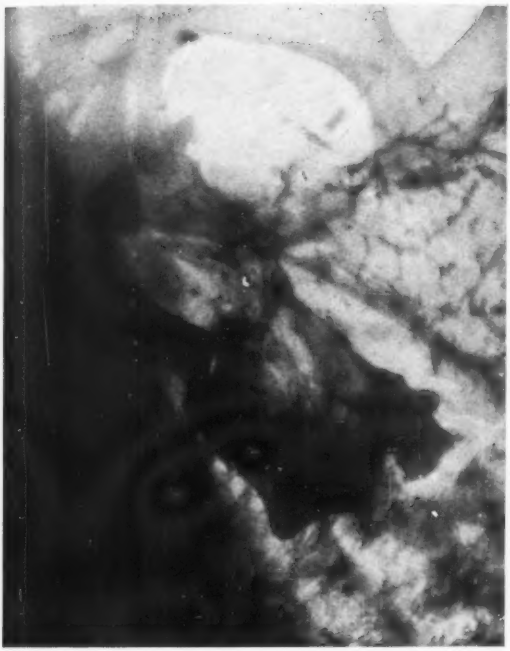
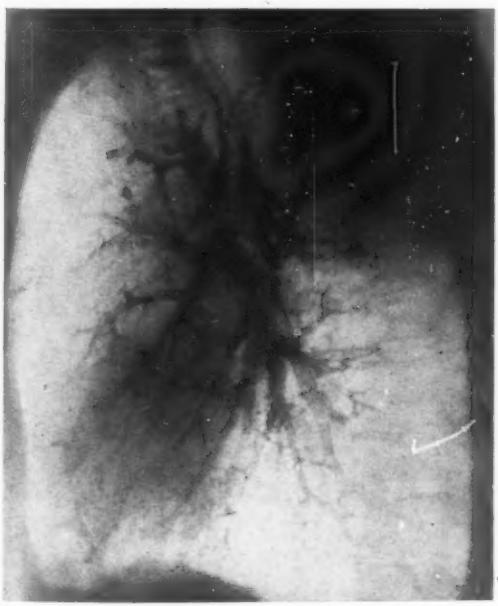
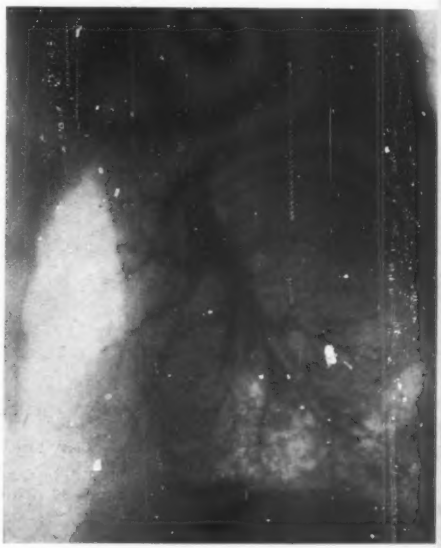


FIGS. 19-20.—LOBECTOMY: LONG STUMP AND PLEURAL POCKET.

Left lower tourniquet lobectomy for bronchiectasis; 18 months after operation had small hæmoptysis. Fig. 19. P.A. bronchogram (contact print). Fig. 20 (reduced print), Left lateral bronchogram, showing long, slightly irregular lower lobe stump leading into almond-shaped pleural pocket lying posteriorly.





FIGS. 21-22.—EFFECT OF RESPIRATORY PHASE ON BRONCHOGRAM.

Left lateral bronchogram: Fig. 21, taken on full inspiration, and Fig. 22, on expiration. Appearances in Fig. 21 simulate slight bronchiectatic changes, but Fig. 22 reveals normal bronchial tree. Radiographs should be taken after a normal as opposed to a full inspiration.

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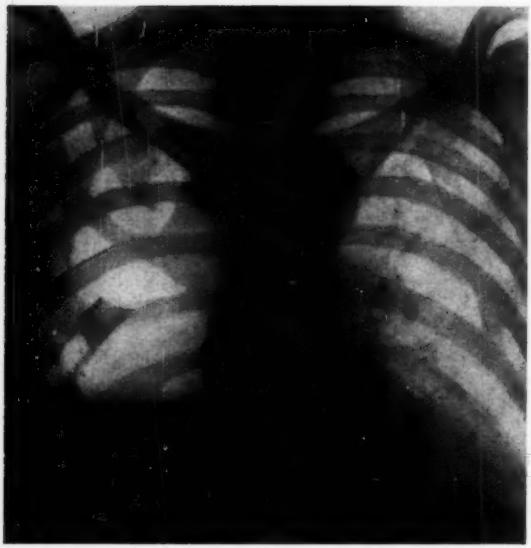


FIGS. 23-24.—PNEUMONECTOMY: EARLY APPEARANCES.

Right pneumonectomy for carcinoma. Fig. 23, A.P., and Fig. 24, Right lateral radiograph 2 days after operation, showing normal position of mediastinum, and small fluid level below tube which is too long.

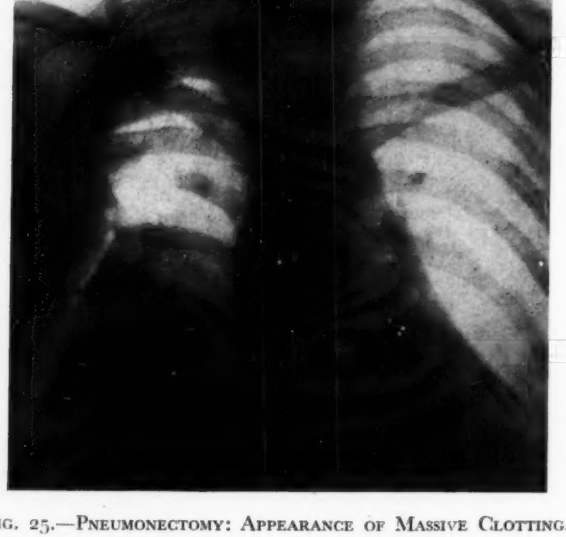


FIG. 25.—PNEUMONECTOMY: APPEARANCE OF MASSIVE CLOTTING.

Right pneumonectomy for bronchiectasis. A.P. radiograph 5 days after operation, showing large spherical opacity in lower part of pleural cavity produced by blood clot. A functionless tube was showing buried in the clot.

To face page 61.

The Pleural Space.—The condition in the pleural cavity depends to a certain extent upon whether or not drainage is employed. In all cases there is a generalised haziness in the region of the removed lobe, due to blood clot and fibrin which invariably form and adhere to the wall of the cavity. Efficient drainage should result in an absence of extensive fluid levels. If such is not the case, the tube is probably incorrectly placed to ensure adequate drainage. In cases where tube drainage is not employed, the sero-sanguineous effusion, which invariably occurs to a greater or less extent, causes a homogeneous opacity at the site of the removed lobe; a fluid level is present unless all the air has been expelled or absorbed, or unless the entire contents have clotted. Effusions after lobectomy have a great tendency to become loculated and the pockets so formed may become completely separated from one another. These pockets differ in their subsequent behaviour. Some readily absorb and disappear; others remain stationary and sterile, whilst yet others become purulent. Thus it is important that these pockets should be adequately demonstrated and localised radiologically, so that the condition which obtains in the various compartments of the pleural cavity can be discovered by means of aspirating. Penetrating films in two planes are essential for this purpose.

The Bronchogram.—In the late assessment of results, and in the investigation of such late complications as hæmoptysis and purulent sputum, bronchography is of immense value. In this way, the stump of the removed lobe is demonstrated, pleural pockets communicating with the stump or a bronchus are outlined, and residual bronchiectasis in the remaining lobe is revealed.

The bronchial stump varies in size according to the type of lobectomy employed. Dissection and individual ligation of the hilar structures enables one to leave a much shorter bronchial stump (Fig. 18) than is possible with the use of a tourniquet (Fig. 19). Infection, with the formation of granulation tissue and the production of pus, may occur in the stump. This is more frequent in the longer stumps, and the combination of granulation tissue with secretions tends to produce in the X-ray picture an appearance of shagginess in the bronchial cul-de-sac.

Small pleural pockets (Figs. 19-20) around the stump not infrequently become shut off from the general pleural cavity whilst the latter is being drained. They do not give rise to trouble at the time, nor do they impede healing of the main cavity, since they usually communicate freely with the bronchial tree through the stump. But they frequently lead to persistence of cough and sputum, or to periodic bouts of pyrexia, followed by expectoration of pus. These pockets are important, and it should be readily possible to demonstrate them by the bronchogram, in which they may appear as small rounded or almond-shaped cavities usually lying posteriorly, and (in the case of the lower lobe) towards the costo-vertebral sulcus.

Residual bronchiectasis, either segmental, such as that in the lingula process of the left upper lobe, or total, requires good bronchograms for its demonstration. More than 10 c.c. of oil is rarely required as it is easy to overfill the bronchial tree in these cases. A point of interest in this connection arises from the fact that there is a normal physiological dilatation, which occurs at the height of inspiration and which may simulate a minor degree of bronchiectasis (Figs. 21-22). It is better, therefore, to avoid taking the films

in full inspiration. After left lower lobectomy, the lingula process requires special study, as it sometimes happens that what appears to be a normal lingula before operation shows bronchiectatic changes after removal of the lower lobe. Occasionally only one branch of the lingula process is removed instead of both, and a dilated residual branch may be the cause of persistent cough and sputum.

(*b*) *Pneumonectomy.*—Apart from the occurrence of infection in the opposite lung, the chief concern of the surgeon is with the residual pleural space as in the case of lobectomy (Figs. 23-24).

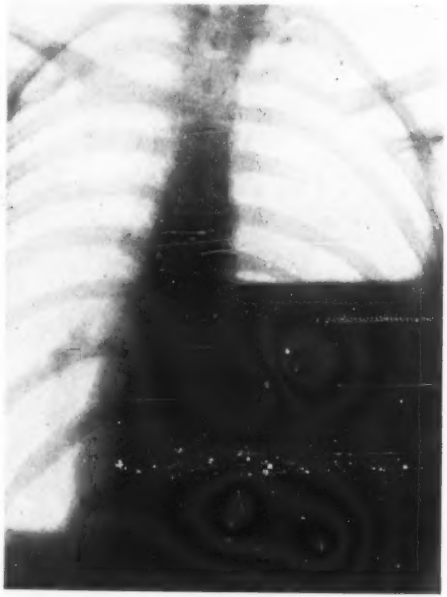
Since importance attaches to the position of the mediastinum it is necessary in the taking of the radiograph that rotation of the patient be avoided. This may be difficult in many patients soon after operation, but care and time spent in achieving it is well repaid. The next important point to consider is the position of fluid levels. These depend to a certain extent upon whether tube drainage has been employed or not, for the fact that the drainage tube is usually placed deliberately above the lowermost limit of the cavity means that the pleural cavity is rarely completely dry. Clotting (Fig. 25) is not infrequent, and may give rise to confusion unless its possibility is recognised. The presence of clot as a triangular or spherical mass, projecting above a small fluid level, has been described in connection with extra-pleural pneumonolysis. Pockets of effusion (Figs. 26-27) may occur, especially after a week or more, and it is important that these should be recognised in the radiograph, for they may need aspirating separately in view of the changes that the fluid may undergo. The diaphragm is usually raised after pneumonectomy (Figs. 28-29), even though the phrenic nerve has not been deliberately interrupted. Some surgeons employ routine diaphragmatic paralysis, and in such cases the rise of the diaphragm may be considerable. Due allowance must be made for this in assessing the quantity of fluid present and determining the site for aspiration. On the left side, the air bubble in the fundus of the stomach forms a good index of the position of the diaphragm, and this bubble may be accentuated by giving the patient an effervescent drink before taking the radiograph (Figs. 28-29).

The residual space formerly occupied by the lung gradually becomes smaller as the mediastinum and chest wall approximate, the diaphragm rises and the pleura becomes thickened. Finally the residual pocket becomes filled with fibrin and loculated fluid, which over a period of time is converted into fibrous tissue. Sometimes late infection of the residual space occurs via the bloodstream or bronchial stump. In the latter case bronchography may reveal the communication between the stump and the cavity. Very penetrating films will be required to reveal pockets of air and fluid through the fibrous tissue, whilst delineation of the diaphragm is valuable.

Summary

The techniques and problems of radiology in the post-operative management of patients undergoing chest surgery are discussed, and representative radiographs shown. Lateral as well as anterior films are essential, and modified centring, exposure and penetration are often required. The techniques and value of pleurography and cavernography are described.

PLATE XIX.

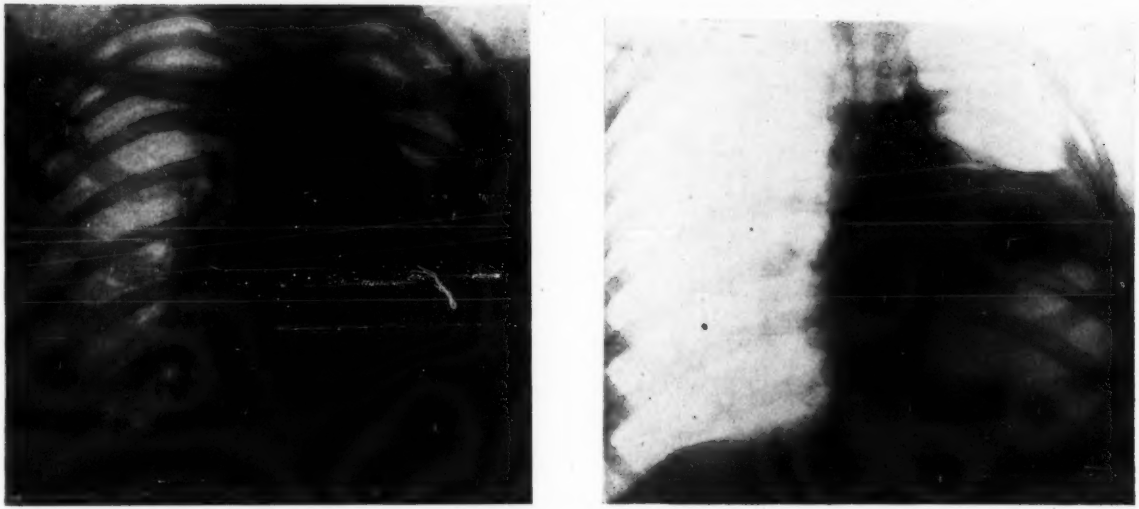


FIGS. 26-27.—PNEUMONECTOMY: MULTIPLE POCKETS.

Left pneumonectomy for lung abscesses. Tube drainage for 48 hours. Fig. 26, A.P., and Fig. 27, Left lateral radiographs about 1 month after operation, showing two pockets with separate fluid levels. Upper pocket contained sterile straw-coloured fluid, whilst lower (mistaken for stomach bubble in A.P. film) contained foul pus.

[*To face page* 62.

PLATE XX.



FIGS. 28-29.—PNEUMONECTOMY: LATE APPEARANCE.

Pneumonectomy for secondary osteogenic sarcoma. Fig. 28, P.A. radiograph with normal penetration, and Fig. 29, Penetrating film after effervescent drink, 5 months after operation, showing position of raised diaphragm well outlined by gas in stomach and above it residual pleural space exhibiting small fluid level.

[*To face page* 63.

An account is given of the normal and complicated appearances which may be found after each of the three major types of operation on the chest; those on the chest wall, those on the pleural cavity, and those on the lung.

We wish to thank Mr. C. Price Thomas and Mr. Norman Barrett for permission to reproduce radiographs of patients under their care, and Dr. Clifford Hoyle for his valuable assistance in the preparation of the paper.

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MENTAL SYMPTOMS IN TUBERCULOUS MENINGITIS

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THE mental features of tuberculous meningitis are seldom stressed in the briefer accounts of the clinical course of the disease. Thus in one of the few recent descriptions Schlapobersky (1937) does not mention the form in which mental symptoms predominate, though in a careful and detailed analysis he refers to such types as the gastro-intestinal, the hemiplegic, the type resembling encephalitis lethargica and that characterised by early loss of consciousness. It has therefore been thought worth while to record the four following cases, in all of which the mental features provided the presenting symptoms.

Several such cases have been reported recently. A paper by Allan Walker (1935) stated that in the early stages, "depression, moodiness, irrational emotional cycles, loss of memory and lack of concentration" are common. He also observed in his 45 cases paranoid states and euphoria with speech disturbances, as in G.P.I. Later on there were delirium, stupor and coma.

Villacian (1933) saw three patients who died of tuberculous meningitis and in whom mental changes for a long time preceded the meningitic phenomena. In one of them the mental changes were only mild, in another there was a pronounced manic state, and in a third a depressive state.

Taussig and Haskovec (1930) reported four cases with a basilar tuberculous meningitis in whom there were interesting mental findings. One of the patients was a chronic drunkard and his delirium was very like delirium tremens; another who had had epileptic attacks in childhood had severe excitement besides the delirium. This type of case has of course been well recognised since the exhaustive paper by Redlich (1908) on the subject. He stated that the frequency of mental symptoms as a presenting feature would be more generally recognised if a detailed history were taken in all cases. The condition in his patients was likened to that in delirium tremens, and he mentioned that in many of them the mental symptoms were so pronounced that it was necessary to transfer them to a psychiatric clinic. He thought, however, that there was no

characteristic mental picture and that the condition may resemble any psychosis, instancing as symptoms catalepsy and flexibilitas cerea. The only feature in common is the speed with which the mental state changes and merges into coma. A brief mention of mental symptoms was made by Kinnier Wilson (1940), who quoted a case with symptoms of "hysteria"; by Warrington (1910), whose cases, however, showed only mild depression and some confusion; and by Oppenheim (1923). Warrington's rendering into English of Redlich's account was rather misleading in that he stated that the patients behaved as though under the influence of alcohol, whereas Redlich clearly meant as though they were chronic alcoholics (*i.e.*, as though they had an alcoholic psychosis).

From the history available it does not appear that alcoholism was a major factor in any of the following examples.

Case Records

CASE 1.—F.B., male, aged 39. Admitted June 15, 1940. The patient left a sanatorium in March 1940 after being treated there for five months for pulmonary tuberculosis. He remained quite well until five weeks before admission, when he had an attack of diarrhœa lasting about one day. For the last eight days he had been ill with pains in his back and legs, and from the day before admission had been delirious. On admission he was extremely ill, restless and wandering. He was so restless that physical examination was necessarily incomplete. There were crepitations at the right base. The pupils were equal and active to light, but it was impossible to examine the fundi. There was no neck rigidity. The abdomen was rigid and the plantars were flexor. He took fluids with difficulty and was restless, confused, incoherent and visually hallucinated, his mental condition closely resembling that in delirium tremens. On June 6, 1940, there were lucid moments during which he would answer rationally if his attention could be secured, but would soon lose the thread of conversation and wander off again. He groaned at frequent intervals but denied feeling pain. On June 18, 1940, a lumbar puncture produced a slightly opalescent fluid with a cobweb clot. The findings were as follows: There were no red corpuscles; a white cell count showed 182 polymorphs and 78 lymphocytes per cubic millimetre. There was an excess of globulin with the total protein raised to 400 mg. per cent.; the chlorides were 630 mg. per cent. Very occasional tubercle bacilli were seen. No other organisms were found. The blood W.R. and Kahn test were negative. The blood pressure was 155/90. The subsequent course was typical of tuberculous meningitis and he died on June 19, 1940.

Post mortem there was considerable emaciation. A cavity was found at the left apex. There was tuberculous broncho-pneumonia affecting all lobes of both lungs. There was also tuberculous meningitis with some hydrocephalus.

CASE 2.—J. B. B., male, aged 32. Admitted June 18, 1940. Pulmonary tuberculosis was first diagnosed in 1932, when the patient spent three months in a hospital for its treatment. Since then he had been at home but was not working. His best weight was 9 stone 10 lbs., as compared with his present weight of 8 stone 7 lbs. He had a cough and was bringing up about 3 oz. of blood-stained sputum daily. On June 10 the patient developed a headache, with nausea and a rise of temperature. After this he vomited occasionally, but for the three days prior to admission he vomited incessantly. He also complained of pain in his right loin.

On admission he appeared somewhat euphoric. He was flushed. The breath sounds were vesicular and there were some medium râles at the right base, and scattered rhonchi. The appetite was poor, and there was vomiting and some epigastric discomfort. He appeared to be deaf. The temperature was 100°.

On June 19, 1940, he was pale and emaciated. The abdomen was held rigid. The liver edge was almost a handsbreadth below the costal margin. The liver condition was attributed to amyloid disease. He was sleepless and refused all food.

Next day a radiograph of the chest revealed large cavities in both upper zones, and calcified nodules in the left mid-zone. A barium meal showed no evidence of ulcer or new growth.

On June 22, 1940, he was strange in manner and persisted in loudly slapping his thighs. He was very hyperactive and continually getting out of bed. He was very restless, difficult to manage, and talked to himself incessantly.

A few days later, on the 25th, the mental symptoms which all along had been a noticeable feature of the case reached their maximum intensity. The patient continually got out of bed and took off all his clothes and stripped his bed. The previous night there was an air-raid warning, and during this he successfully diverted the attention of his fellow patients to himself by getting out of bed, stripping himself naked, doing physical jerks in the middle of the ward, violently scratching his belly, and as a grand finale drinking the contents of his sputum cup including the monsol which it contained. When questioned he was unable to give any coherent account of himself, but chattered continually in response to imaginary voices. He also appeared to be visually hallucinated. At times he was very aggressive in his manner and shouted at the top of his voice.

On the 26th he was hallucinated during the early part of the day, but later became comatose and died.

There was an irregular pyrexia from the date of admission till death, varying from 98° to 101°.

Post-Mortem Findings.—There was extensive pulmonary tuberculosis with amyloid deposits in liver and kidneys and a tuberculous basal meningitis.

Case 3.—T. G. F., male, aged 40. Admitted December 11, 1941. *Family History.*—The mother died, aged 40, from phthisis when the patient was 14 years old. The father was 72, was still doing farm work and was very fit for his age. *Siblings.*—There were four sisters, all but one married and away from home. The unmarried sister brought the family up. Nothing was known of any mental or nervous trouble in the family. *Personal History.*—He did well at school, was in X7 for 2 years and would have gone to a secondary school with a scholarship had the mother not died at that time. He was very good at figures. *Work.*—He was in the "Co-op" for a time, and was then sent to Glasgow to work by the Labour Exchange, and when work became slack there he was returned to Woolwich, where he went into the building trade. He had always found work easily, going straight from one job to another. He was then a ganger (demolition work). *Personality.*—He was always extremely quiet, rarely made any friends. He had no interests or hobbies. He came home in the evenings and read. He hardly said a word, but was good-tempered. *Health.*—This had been very good. *Present Illness.*—He worked till December 2, 1941, but for some little time previously he had been sitting holding his head in his hands, leaning forward and complaining that the front of his head was painful. On December 2 he was firewatching at 2 a.m.,

and when taking over from the other man fell on the ground for no apparent reason. He was helped by the man and returned to his home. He went into his sister's room to return her clock, and seemed very clumsy and noisy in all his movements, but said he was all right. The next morning he announced that he was staying in bed as his head was aching so badly, and he slept most of that day. The following day he got up and went to the doctor, who recommended a week's rest and also gave him a letter to take to hospital. On December 8 he set out at 12.30 to go to hospital, but returned about 4 p.m. and said he did not know what had happened to him—he could not remember what he had been going to do (he had not been to hospital). From that time he began to wander in conversation—would begin to say something and then forget what it was—but most of the time he slept. On the 9th he got up at dinner-time without being told and ate his meal. The sister went out shopping and on her return she found he had moved all the things from the dresser and spread them over the table. In the evening he refused to go to his bedroom for a long time, saying he could not go into other people's houses. He was up all that night, talking about the construction of the room, the bricks and materials, etc., and then went round the room unscrewing and taking to pieces everything he could find. He took the wireless entirely to pieces. He began pulling down the wallpaper, climbed on to the windowsill and hung on to the window for a considerable time.

On admission to hospital he was said to be suffering from delusions. He was unco-operative and did not appear to understand questions. His speech was blurred and his words jumbled together. His general physical condition appeared satisfactory. There were a few inspiratory rhonchi and some crepitations at both bases of the lungs. The right eye was missing (this was ascribed to an accident in childhood). Apart from this and the slurred speech no abnormality was found in the central nervous system.

On December 12, 1941, he appeared fatuously cheerful. He beamed all over his face and greeted other patients and the staff very heartily, being under the impression we were old friends of his whom he had not met for some long time. He shook hands most effusively with everybody. He appeared definitely demented and his cerebration was very much slowed. He had great difficulty in grasping what was said to him. Thus when asked his age he at first replied " 5 ft. 6 in." and then " 36." He did not know the day of the week and did not appear to grasp where he was. There was no complaint of headache at the time of examination. His speech was still slurred. The pupil reacted to light. The left plantar was doubtfully extensor, the right flexor. The blood pressure was 165/120. There was slight blurring of the nasal margin of the optic disc, otherwise the fundus was normal. At this time a diagnosis of cerebral tumour was considered the most likely, but the possibility of G.P.I. was borne in mind. An X-ray of the skull showed no abnormality.

Next day he appeared slightly more rational, but his general condition was not so good. The tongue was furred, there was halitosis and the temperature had risen to 100°. At this stage a considerable wasting of the right calf was noted, also to a lesser extent of the right thigh. This was thought to be due to an old poliomyelitis.

On the 15th the C.S.F. pressure was found on lumbar puncture to be more than 350 mm., which was the highest pressure recorded by the instrument used. The fluid was slightly opalescent, there were no red corpuscles, but there were 97 polymorphs and 33 lymphocytes per cubic millimetre; there was a considerable excess of globulin and the protein was raised to 400 mg.

per cent.; the chlorides were reduced to 595 mg. per cent. A few tubercle bacilli were seen. No other organisms were present.

The subsequent course was typical of tuberculous meningitis and he died on December 17, 1941.

Post mortem there was tuberculous broncho-pneumonia of the left lung, and a tuberculous basal meningitis with marked injection of the meninges on all surfaces of the brain.

CASE 4.—A. H., male, aged 56. Admitted June 7, 1941, and treated in a general ward. This patient was stated by his friends to have become strange during the past ten days and to have rambled in his conversation. On admission he was extremely restless. Both plantars were extensor. This and the restlessness were both attributed to anoxæmia due to heart failure, for he had an old rheumatic carditis with some evidence of congestive cardiac failure.

He proved difficult and unco-operative, and although he was cyanosed it proved impossible to give him oxygen either by nasal catheter or B.L.B. mask. His condition became worse and he developed a muttering delirium. He remained very restless. Although meningitis was not suspected then a lumbar puncture was done as a therapeutic measure for his restlessness. The pressure was 290-310 mm. C.S.F., the fluid was clear and colourless, there were no red corpuscles, but 207 polymorphs and 23 lymphocytes per cubic millimetre; there was an excess of globulin, the protein content was raised to 220 mg. per cent. and chlorides were reduced to 580 mg. per cent. A few tubercle bacilli were seen. There were no other organisms. The Wassermann was negative and the Lange test gave the following result: 0000012210 (0).

He died on June 10, 1941.

Post Mortem.—There was generalised miliary tuberculosis with tubercles in the lungs and small intestines, with a large caseous area in the left kidney. There was also an old rheumatic carditis with a distorted aortic valve. There was a tuberculous meningitis affecting both vertex and base, especially the Sylvian fissure.

Discussion

The third of these patients was the most striking illustration of the prominence which mental abnormality may occasionally assume in tuberculous meningitis; for there was nothing in the history to suggest either tuberculosis or meningitis apart from the persistent headache. The three cases admitted to the unit occurred out of a total of 685 cases admitted during two years. Although this incidence is small it does demonstrate that tuberculous meningitis needs to be borne in mind in the differential diagnosis of ill-defined confusional states associated with pyrexia, especially where a pulmonary lesion is known to exist.

The mental features are in no way diagnostic. It is only possible to say that one is dealing with a confusional state of organic origin, and indeed the distinction between this type of case and an acute mania is not always clear, especially when the latter has received the usual heavy doses of sedatives.

There is a striking similarity between these cases and those recorded by Weir and Vautier (1942) in cerebro-spinal fever. They state that there " the mental symptoms though really secondary to the main illness overshadow the true condition, the real nature of the illness being overlooked."

The clinical course of Case 3 would have been consistent with a diagnosis of the acute onset of general paresis or of a cerebral tumour. The diagnosis was only decided by the lumbar puncture findings. It is well to emphasise once again the value of routine lumbar puncture in such cases.

These case histories further serve to illustrate the importance of the careful exclusion of all physical lesions before concluding that behaviour disturbances are entirely psychogenic. In an important minority of patients admitted to this unit an organic basis for mental changes is found, whether it be cerebral tumour, drug intoxication, vitamin deficiency, circulatory changes, hypoglycæmia, endocrine disturbances, pyrexia, toxæmia, encephalitis, or meningitis.

Summary

Four cases are recorded of tuberculous meningitis with mental features at the onset.

Attention is drawn to this lesion in the differential diagnosis of confusional states.

The value of a routine lumbar puncture in this group of conditions is emphasised.

My thanks are due to Dr. Allan Daley, Chief Medical Officer of the London County Council, for permission to publish; to Dr. B. A. Young, Medical Superintendent, for advice; to Dr. Eli Davis, who supplied details of Case 4, and to the medical and technical staff of St. Alfege's Hospital and the South-Eastern Group Laboratory for their kind assistance.

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AN INVESTIGATION ON BLOOD GROUPS IN TUBERCULOSIS

By M. WEINBERGER.

From Papworth Village Settlement.

Intensive study of the bacteriology and pathology of tuberculosis during the last sixty years has shown that infection alone is not sufficient to account for the disease. While there is no tuberculosis without an infection with Koch's bacillus, of those infected many remain in good health. "We are more and more convinced," wrote Fishberg, "that phthisiogenesis is more a problem of predisposition than of bacterial infection." Disease is the expression of the reaction between a complex set of external agents and an equally complex

organism striving to survive. The capacity to resist is a constitutional quality modified to a certain extent by environmental influence (Draper).

The problems presented by these constitutional factors in tuberculosis are still of great interest. For instance, attempts have been made to establish a correlation between anthropo-morphological types and the incidence of the disease. Most authors base their work on purely anatomical morphological observations, an example being the "Habitus asthenicus Stiller." But pure morphological characteristics are not always reliable indices of constitutional factors, and, as some authors suggest, may be regarded rather as a consequence of the disease than a predisposing condition.

In the study of constitutional factors in tuberculosis we have to look for characteristics which are essentially constitutional—*e.g.*, constant, unchangeable, independent of environmental, social or economical conditions. In human physiology there are few other elements which better meet these requirements than the human blood groups.

Shattock discovered the phenomenon of iso-hæmoagglutination at the end of the last century, and thought that it was a reaction due to disease; later, Landsteiner found that blood groups are constant characteristics of the person, differing from individual to individual, and he outlined the general principles governing the phenomena and described the blood grouping test. He discovered three groups, and a fourth was subsequently found by Moss.

The capacity of a serum to agglutinate depends on its agglutinin content; that of the red cells to be agglutinated on their agglutinogen content. The human blood contains two agglutinins in the serum, and two agglutinogens in the red cells. The former are considered secondary antibodies and the latter antigens; these factors are variously distributed. When one of the two agglutinogens is present in the red cells the corresponding agglutinin is always missing from the serum. When the red cells contain both agglutinogens no agglutinins are present in the serum. Four agglutination combinations are thus possible, hence the classification into four blood groups.

For some time these groups were denominated by three different terminologies, but this proved to be very confusing. Today, the nomenclature universally accepted is that recommended by the League of Nations—viz., the letters O, A, B and AB. These denominations have been used in the course of the present survey.

The characteristics of Group O (universal donor) are as follows: The red cells do not contain any agglutinogens, and are not agglutinated or hæmolised by any serum. The serum contains both agglutinins, and agglutinates all other red cells except its own.

The Group A red cells contain the A agglutinogen and the serum B agglutinin. Therefore, A cells are agglutinated by B serum containing A agglutinin, and by O serum which contains both agglutinins. The A serum agglutinates both B and AB cells.

The Group B red cells contain the B agglutinogen and the serum A agglutinin. Cells of the B group are, consequently, agglutinated by the serum of both Group A and Group O. The serum of Group B agglutinates cells of both A and AB groups.

The Group AB cells contain two agglutinogens, the A and the B, but the

serum does not contain any agglutinins. The AB cells are agglutinated by all other sera except by its own, but the serum AB, not containing agglutinins, does not agglutinate the red cells of any group (universal recipient).

The presence of group specific substances (iso-antibodies) is not confined to the blood, as recent studies have revealed their presence in most organs, tissues and body fluids, normal and pathological.

Quantitative variations have been reported in the blood, and other sites, in relation to age (lower agglutinin titre in both the infant and the aged) and to disease (Holscher). All agree, however, that the group specific quality remains a constant characteristic of the person throughout life, and the few reports suggesting changes under therapeutical influences have not been confirmed.

The capacity for antibody production is inherited. Hirszfeld formulated the hypothesis that the normal antibodies can be regarded as inherited serum structures, " biochemical organs." Investigations by Hirszfeld and Brockman, on diphtheria susceptibility in connection with blood groups, has called attention to a possible relationship between the process of immunity and blood groups. In the child there seems to be a parallelism between the appearance of iso-antibodies and bacterial antibodies.

Hirszfeld and his wife have shown that blood group distribution varies in different parts of the world. In Europe the Group A is more frequent. From west to east the proportion of Group A decreases, whilst that of Group B increases.

Following the discovery of the blood groups and their transmission according to the Mendelian laws of heredity (Van Dungern and Hirszfeld), attempts have been made to show that people belonging to certain blood groups are more likely to contract specific diseases. Some authors have tried also to demonstrate an existing relationship between one of the blood groups and the course of the disease. Some authors, in the numerous papers on the subject, fail to find any connection, but many others maintain that a definite relationship exists between blood groups and disease. In practically every instance contradictions and discrepancies are reported.

The present paper deals with blood groups in connection with tuberculosis, and especially with pulmonary tuberculosis, a subject which has already been the topic of a limited number of investigations. Ernst, Connert, Parr, Hollo and Lenart, Searle and Horan, all agreed that there is no relation between susceptibility to tuberculosis and any of the blood groups; nor could they demonstrate any correlation between resistance and any specific blood group. On the other hand Alperin, Kallabis, Svider and Kon, found that patients belonging to Group A were more susceptible to tuberculosis, while those belonging to Group O were more resistant. Schmidt states that the prognosis of patients belonging to Group O is worse than in those belonging to Group A. K. T. Sasano affirms that patients in Group A respond better to treatment than those in Group O, but that greater susceptibility to tuberculosis could not be found in any particular blood group.

Only two references by English authors on this subject have been traced. W. Alexander, reporting on 50 cases of tuberculosis, found a higher incidence

of Group O. Reports by Bradbury on the same subject (626 cases, reported in detail in Table II) are more interesting and important. His main conclusions are that the blood group distribution of tuberculous persons differs from that of non-tuberculous ones, and that those belonging to Group O are more liable to contract tuberculosis than those belonging to other groups. Bradbury goes on to suggest the hypothesis that infection with the tubercle bacillus may, to some extent, depend upon the relative blood group of donor and recipient of infection (conjugal tuberculosis).

In view of these contradictory reports, and the great importance of the questions involved, the present investigation has been undertaken. It has two main objects: the first relates to the question of susceptibility, and the second to the question of resistance. Is it true that a person belonging to any specific blood group is more predisposed to tuberculosis, and, had they belonged to any other group, would their resistance to such infection have been greater? Should a careful study confirm this point, the implications for preventive medicine are obvious. It is important also to know whether any correlation between blood group and the course of the disease and other features, such as hæmoptysis, X-ray characteristics, or the presence of cavitation can be traced.

Material and Methods

The material, collected in the various wards of the Papworth Village Settlement, comprises 1,000 cases of pulmonary tuberculosis and 117 of non-pulmonary (bone, glandular, skin, urogenital) tuberculosis, and covers the admissions and discharges between September 1941 and August 1942. Reference is made also to another 405 cases, studied in less detail, at the Cheshire Joint Sanatorium during the period September 1939 to May 1940.

The cases used in the present series were unselected, and acutal typing and classification being done independently in order to avoid subjective influences. The number of cases actually typed was about 4,000. A correct technique is essential for reliable results, and no doubt some of the contradictory results noted above may have been due to imperfect technique.

The materials required for the grouping reaction are red blood cells and typing sera. The red cells were, in most cases, obtained by using blood taken from the patients for routine blood sedimentation test purposes. This was, of course, citrated blood, which, for grouping purposes, had to be further diluted with normal saline in order to obtain a 2 per cent. suspension. The use of a too concentrated blood cell suspension may, as a consequence of rouleaux formation or pseudo-agglutination, cause false positive results. For the same reason, false negative results may sometimes occur if the cells are not sensitive enough, or if the serum is too weak. The typing was done on the same day that the blood specimen was obtained. This is essential, as delay may result in the deterioration of the blood cells, by bacterial contamination, and cause false results. False results may also ensue, due to cold agglutinins, through using cells too soon after being in refrigeration.

The Serum Unit of the Galton Laboratories, Dept. of Pathology, Cambridge University, kindly supplied the testing sera used, and we take this opportunity

of expressing our great thanks to them. The sera, when checked for potency, were always found to be satisfactory.

Suitable serum reacts in a dilution of 1 in 64 to 1 in 128. Bacterial contamination of the sera may easily cause false positive results, and special attention must be given to this source of error in cases where Group O may be mistaken for Group AB.

The typing test was carried out at room temperature by the slide method. Because of the large number of cases dealt with, a glass plate, 12 inches long by 2 inches wide, was used instead of single microscopic slides. The plate was divided, by means of a wax pencil, into twenty-four sections, four of which were reserved for controls. Two separate drops of cell suspension were placed in each section, and one drop each of undiluted serum, A and B respectively, was added. Mixing was effected by tilting the plate. Positive results were usually recognisable, and clearly seen with the naked eye, within a few minutes. Half

TABLE I.—STATISTICS ON BLOOD GROUP DISTRIBUTION AMONGST THE NORMAL POPULATION OF THE BRITISH ISLES, WITH PARTICULAR REFERENCE TO THE REGIONAL ORIGIN OF THE PEOPLE TYPED

Author.	*Region.*	*Total Typed.*	*Blood Group Distribution, Percentage of each Category.*			
			O.	*A.*	*B.*	*AB.*
Fisher and Taylor	Scotland	10,969	52·01	34·42	10·42	3·31
	N. England	8,716	48·60	40·34	8·53	2·52
	S. England	106,477	45·23	43·16	8·50	3·09
Ikin, Prior, Race and Taylor ..	England	3,696	43·72	44·21	8·84	3·21
Thomas	England	5,000	44·66	43·24	8·88	3·22
Jones and Glynn	Liverpool	1,600	46·00	30·00	17·00	7·00
McLeod	Manchester	1,927	48·72	41·10	7·68	2·49
Kirvan and Taylor	London	500	40·40	46·80	9·60	3·20
Race	Cambridge	856	44·16	45·79	7·36	2·69
Penrose and Penrose	Eastern Counties Mental Cases	1,000	43·20	47·70	6·40	2·70
Sachs	Ireland	2,435	53·63	32·36	11·46	2·54

an hour afterwards a second reading was always made by two independent observers, questionable results being repeated and examined microscopically. In most of the cases the testing was repeated a second time, and in occasional cases even a third. It was not possible to check the grouping by using unknown sera against known cells, but accuracy was assured by the use of fresh, high titre sera, fresh cells, and, finally, by controlling the regular working of the reaction by using at least two known cells on every occasion. Attention was also given to sub-groups, A2 for example, which can only be detected by using strongly reacting sera.

Results

The blood group distribution of the normal population had first to be considered, and data on this subject are given in Table I. The wide variations found by the several authors are the main feature of this summary. Another

particularly interesting point is that variations, which mostly concern groups O and A, are connected with the different regions to which the typing results of these authors refer. The findings of Fisher and Taylor, which are based on very large numbers, show that in the British Isles from north to south there is a gradual increase in the percentage of people belonging to Group A, whilst the percentage of those belonging to Group O similarly decreases. Sachs has shown that the highest incidence of Group O is to be found in Ireland.

The figures in Table I were of considerable help in assessing the value of the findings (see Table II) on blood group distribution amongst tuberculous patients. In commenting on these findings it seemed more interesting to consider only groups O and A; firstly, because of the greater number of cases

TABLE II.—STATISTICS, BY ENGLISH AUTHORS, ON THE BLOOD GROUP DISTRIBUTION OF TUBERCULOUS PATIENTS

Author.	*Total Typed.*	*Classification.*	*Blood Group Distribution, Number Typed, and Percentage of each Category.*			
			O.	*A.*	*B.*	*AB.*
Alexander	50	—	50·00	34·00	12·00	4·00
Bradbury	626	T.B. plus.	233	124	27	8
		(392)	59·00	32·00	7·00	2·00
		T.B. minus	61	30	11	0
		(102)	60·00	29·00	11·00	—
		All pulm.	294	154	38	8
		(494)	59·50	31·00	8·00	1·50
		Non pulm.	17	11	1	0
		(29)	59·00	38·00	3·00	—
		All T.B.	311	165	39	8
		(523)	59·50	32·00	7·00	1·50
		Non T.B.	45	42	11	5
		(103)	44·00	41·00	10·00	5·00
		All cases	356	207	50	13

involved, and secondly, because the variations concern mainly these two groups.

Bradbury, in Lancashire, found that a very high incidence (59·5 per cent. of Group O against 32 per cent. of Group A) of tuberculous patients belonged to Group O, and, in view of this, he concluded there was a major susceptibility to tuberculosis amongst members of this group. The findings at the Cheshire Joint Sanatorium (see Table IIIA) were similar to those of Bradbury, although the incidence (55 per cent. of Group O against 33·33 per cent. of Group A) of Group O was less marked.

At the Papworth Village Settlement (see Table IIIB) Group O and Group A were equally proportioned in all the (1,117) tuberculous patients typed. In the case of pulmonary tuberculosis only (1,000 cases), the incidence of Group O (45·6 per cent.), although higher than Group A (42·2 per cent.), certainly does not show a marked difference between the two. With regard to non-pulmonary tuberculosis, although a higher incidence of Group A

(51·28 per cent.) than Group O (41·88 per cent.) prevailed, the small number of cases (117) typed does not enable one to draw definite conclusions.

The patients dealt with at Papworth came from all parts of the country.

TABLE III.—PERSONAL OBSERVATIONS ON BLOOD GROUP DISTRIBUTION AMONGST TUBERCULOUS PATIENTS

(*a*) *At Cheshire Joint Sanatorium.*

Regional Origin.	*Classification.*	*Total Typed.*	*Blood Group Distribution, Number Typed, and Percentage of each Category.*			
			O.	*A.*	*B.*	*AB.*
Midlands	Total patients typed Sept. 1939 to May 1940	— 405	233 55·04	135 33·33	37 9·11	10 2·49
	Patients present on Feb. 6, 1940	— 233	130 55·77	70 30·04	25 10·72	8 3·57
	Patients discharged Dec. 1939 to May 1940	— 150	79 52·66	52 34·66	15 10·00	4 2·66

(*b*) *At Papworth Village Settlement,* 1941–1942.

Total Typed.	*Classification.*	*Blood Group Distribution, Number Typed, and Percentage of each Category.*			
		O.	*A.*	*B.*	*AB.*
1,117	Pulmonary and non-pulmonary	505 46·10	482 46·15	88 7·87	42 3·78
	Pulmonary (1,000)	456 45·60	422 42·20	83 8·30	39 3·90
	Non-Pulmonary (117)	49 41·88	60 51·28	5 4·27	3 2·56

(*c*) *Regional Variations.*

Total Typed.	*Region.*	*Blood Group Distribution, Number Typed, and Percentage of each Region.*			
		O.	*A.*	*B.*	*AB.*
525	Eastern Counties	86 46·48	78 43·24	13 7·00	8 3·28
	London and Home Counties	101 46·75	90 41·66	16 7·40	9 4·16
	Other counties	63 50·80	48 38·70	9 7·25	4 3·22

An attempt was made to establish the regional origin of these patients, and in 515 cases satisfactory information was obtained. The patients were classified (see Table IIIc) into three regional categories. It was found that the highest

incidence of Group O fell to those belonging to the category " other counties " (comprising Ireland, Scotland, and Northern England), whilst the difference of incidence between groups O and A was considerably less marked in the other two categories.

Considering these findings, and comparing them with reports by other authors on the blood group distribution of the normal population for the same areas (see Table I), it would seem that the blood group distribution of tuberculous patients does not differ significantly from that of the normal population. Results when based on larger numbers are more significant than when few cases are involved. That special consideration must be given to regional variations is shown by the data of various authors for the normal population, and by the Papworth experiments amongst tuberculous patients. From the

TABLE IV.—THE INCIDENCE OF SEX IN RELATION TO BLOOD GROUP DISTRIBUTION AMONGST 1,000 CASES OF PULMONARY TUBERCULOSIS

Total.	*Category.*	*Blood Group Distribution, Number Typed, and Percentage of each Category.*			
		O.	*A.*	*B.*	*AB.*
1,000	Male (746)	335 44·90	319 42·76	61 8·17	31 4·15
	Female (254)	121 47·63	103 40·55	22 8·66	8 3·14

point of view of blood group distribution, these results do not support the existence of a major, or minor, susceptibility to tuberculosis in relation to any specific blood group.

Incidence of Sex and Age in Relation to Blood Group Distribution

In so far as sex is concerned (see Table IV), there was no significant difference between the blood group distribution of male (746 cases) and female (254 cases) patients, with the exception of a slightly increased incidence of Group O in the latter.

With regard to age (see Table VA), the majority of the patients (47·3 per cent.) belonged to the " twenty-thirty " age group; next (20·2 per cent.) came the " thirty-forty " age group; of the rest, 12·4 per cent. belonged to the " under-twenty " group, the remaining 14·6 per cent. being scattered over all the other age groups.

The distribution of the two major blood groups, the O and the A, may be of interest with reference to age groups. In the " under-twenties " there is a slightly raised incidence of Group A; in the ages between twenty and twenty-five the raised incidence is that of Group O, whilst Group A again slightly predominates in the ages between twenty-five and thirty. The highest incidence of Group O occurs in the thirty to thirty-five age groups, whereas a higher incidence of Group A is found in the thirty-five to forty age group. Above this age Group O shows a predominantly higher incidence than that of

TABLE V.—THE INCIDENCE OF AGE IN RELATION TO BLOOD GROUP DISTRIBUTION AMONGST 1,000 CASES OF PULMONARY TUBERCULOSIS

(a) Combined Male and Female Cases.						(b) Male Cases Only.						(c) Female Cases Only.					
Total Typed.	*Age Groups.*	*Blood Group Distribution, Number Typed, and Percentage of each Age Group.*				*Total Typed.*	*Age Groups.*	*Blood Group Distribution, Number Typed, and Percentage of each Age Group.*				*Total Typed.*	*Age Groups.*	*Blood Group Distribution, Number Typed, and Percentage of each Age Group.*			
		O.	*A.*	*B.*	*AB.*			*O.*	*A.*	*B.*	*AB.*			*O.*	*A.*	*B.*	*AB.*
124	Under 20	57 45·96	58 46·77	6 4·83	3 2·44	91	Under 20	42 46·15	44 48·36	4 4·39	1 1·09	33	Under 20	15 45·45	14 42·42	2 6·06	2 6·06
235	20 to 25	112 47·66	92 39·15	21 8·93	10 4·26	174	20 to 25	79 45·40	73 41·95	13 7·47	9 5·18	61	20 to 25	33 54·10	19 31·14	8 13·11	1 1·65
238	25 to 30	98 41·17	103 43·28	26 14 63	11 4·62	191	25 to 30	78 40·84	85 44·51	21 10·99	7 3·66	47	25 to 30	20 42·56	18 38·30	5 10·63	4 8·51
156	30 to 35	80 51·28	61 39·10	11 7·05	4 2·57	116	30 to 35	60 51·72	42 36·20	10 8·63	4 3·45	40	30 to 35	20 50·00	19 47·50	1 2·50	— —
106	35 to 40	42 39·62	48 45·28	11 10·56	5 3·54	77	35 to 40	28 36·36	37 48·05	7 9·10	5 6·49	29	35 to 40	14 48·27	11 37·93	4 13·80	— —
64	40 to 45	31 48·46	26 40·62	4 6·25	3 4·57	42	40 to 45	23 54·77	13 30·95	3 7·14	3 7·14	22	40 to 45	8 36·36	13 59·10	1 4·54	— —
34	45 to 50	17 50·00	15 44·11	1 2·95	1 2·94	20	45 to 50	10 50·00	8 40·00	1 5·00	1 5·00	14	45 to 50	7 50·00	7 50·00	—	—
39	50 to 60	19 48·71	15 38·47	3 7·70	2 5·12	31	50 to 60	15 48·38	13 41·93	2 6·45	1 3·24	8	50 to 60	4 50·00	2 25·00	1 12·50	1 2·50
4	60 to 70	— —	4 100%	— —	— —	4	60 to 70	— —	4 100%	— —	— —	—	60 to 70	— —	— —	— —	— —
1,000	All Groups	456	422	83	39	746	All Groups	335	319	61	31	254	All Groups	121	103	22	8

Group A. In the sixty-seventy age group there were no patients belonging to Group O, and a relatively high number belonging to Group A.

The interpretation of these variations is, however, both complex and speculative.

Family Histories

Susceptibility, from the point of view of family histories, was another problem approached. Statistical compilations of family histories are often subject to criticism, and rightly so, owing to the lack of accuracy; the informa-

TABLE VI.—THE INCIDENCE OF FAMILY HISTORY IN RELATION TO BLOOD GROUP DISTRIBUTION AMONGST 1,000 CASES OF PULMONARY TUBERCULOSIS

(*a*) *Positive Family History.* 27·9 *per Cent. of all Cases.*

Total Typed and Percentage of Total in each Category.	*Category.*	*Blood Group Distribution, Number Typed, and Percentage of all Positive Family Histories in each Category.*			
		O.	*A.*	*B.*	*AB.*
188	Male	92	79	12	5
25·02		48·93	42·02	6·38	2·65
91	Female	39	40	8	4
31·88		42·85	43·95	8·79	4·39
279	Male and Female	131	119	20	9
		46·95	42·65	7·16	3·22

(*b*) *Negative Family History.* 71·1 *per Cent. of all Cases.*

Total Typed and Percentage of Total in each Category.	*Category.*	*Blood Group Distribution. Number Typed and Percentage of all Negative Family Histories in each Category.*			
		O.	*A.*	*B.*	*AB.*
558	Male	243	240	49	26
74·98		43·54	43·01	8·78	4·65
163	Female	82	63	14	4
68·12		50·30	38·65	8·58	2·45
721	Male and Female	325	303	63	30
		45·07	42·02	8·73	4·16

tion obtained depending on the mentality and memory of the patient, and, in some cases, the interest of the medical officer collecting these data. Nevertheless, a positive family history is of interest, as it is common knowledge that in some families tuberculosis occurs in successive generations, whilst in others the whole family is affected by it. In many cases family contact is responsible for the contracting of the disease, but this does not appear to be so in all instances.

Table VI shows the findings on family history in relation to blood groups. In 27·9 per cent. of all pulmonary cases a positive family history was found, a percentage closely resembling those generally stated in literature on this subject. The incidence of positive family history was found to be higher in

the case of females (31·88 per cent.) than in males (25·2 per cent.). In a group of patients discharged on medical grounds, those with an incidence of positive family history were fewer than those with a negative one.

Of the total cases typed there was, as far as blood group distribution was concerned, no marked difference in favour of any one blood group. It will be noticed, however, that the incidence of positive family history in males was greater in Group O (48·93 per cent.) than in Group A (42·02 per cent.), whilst in females the proportion (42·85 per cent. Group O against 43·95 per cent. Group A) was almost equal. In comparing the figures for male and female cases it will be seen that the percentage of Group O males (48·93 per cent.) greatly exceeded that of females (42·85 per cent.) in the same group, whereas the percentage in Group A (male 42·02 per cent., female 43·95 per cent.) was very similar. The difference in these figures cannot be regarded, however, as sufficiently marked to warrant the conclusion that a greater susceptibility to tuberculosis exists in favour of any specific blood group.

TABLE VII.—MINISTRY OF HEALTH CLASSIFICATION IN RELATION TO BLOOD GROUP DISTRIBUTION AMONGST 1,000 CASES OF PULMONARY TUBERCULOSIS

Ministry of Health Classification.	*Total Typed.*	*Blood Group Distribution, Number Typed, and Percentage of each Blood Group.*			
		O.	*A.*	*B.*	*AB.*
T.B. Minus	302	124 27·19	137 32·46	28 33·73	13 33·33
T.B. Plus I	49	14 3·07	28 6·63	5 6·02	2 5·13
T.B. Plus II	494	225 49·34	218 51·65	34 40·96	17 43·58
T.B. Plus III	155	93 20·30	39 9·24	16 19·27	7 17·94
All groups	1,000	456	422	83	39

Ministry of Health Classification and Blood Group Distribution.

In tabulating our cases (see Table VII) in accordance with the Ministry of Health Classification it was found that 698 belonged to the TB Plus and 302 to the TB Minus categories. In both the TB Minus and the TB Plus I classes the incidence of Group O was comparatively low. In the TB Plus II class the incidence of groups O and A was higher than that of the other two groups. In the TB Plus III category the incidence of Group O was twice that of Group A.

These observations would seem to indicate that Group A predominates in TB Minus and TB Plus I cases, whilst Group O is similarly outstanding in TB Plus III cases. They may also point to a better prognosis for patients belonging to Group A and a less favourable one for those belonging to Group O.

X-Ray Characteristics and Blood Groups

Under this heading the cases were divided into the following four groups:

I. " Exudative lesions ": infiltration revealing a soft, flocculent appearance with irregular margins, and a tendency to show change in serial films.

II. " Productive or fibrotic lesions ": infiltration with more regularly defined margins, firm, hard in appearance, nodular and string-like, and less tendency to show change in serial films.

The majority of cases showed a mixed appearance and were classified, according to the radiological characteristics which prevailed, into the intermediate categories:

III. " Prevalent exudative," and
IV. " Prevalent fibrotic."

The findings, recorded in Table VIII, seemed to indicate a higher proportion of exudative type cases belonging to Group O. The incidence of fibrotic

TABLE VIII.—X-RAY CHARACTERISTICS IN RELATION TO BLOOD GROUP DISTRIBUTION AMONGST 1,000 CASES OF PULMONARY TUBERCULOSIS

X-Ray Characteristics.	*Total Typed.*	*Blood Group Distribution, Number Typed, and Percentage of each Blood Group.*			
		O.	*A.*	*B.*	*AB.*
Exudative	82	53	23	4	2
	8·20	11·62	5·45	4·81	5·12
Fibrotic	153	38	86	22	7
	15·30	8·33	20·38	26·50	17·94
Prevalent Exudative	248	128	93	19	8
	24·80	28·07	22·03	22·89	20·51
Prevalent Fibrotic	517	237	220	38	22
	51·70	51·97	52·10	45·78	56·41
All Groups	1,000	456	422	83	39

lesions was high in Group A and highest in Group B. In the intermediate types, " prevalent exudative " and " prevalent fibrotic," the differences with regard to blood group distribution were less noticeable.

Incidence of Cavitation

Radiologically obvious cavities only were taken into consideration. On admission the incidence of cases with cavitation was fairly high, being found in 583 (58·3 per cent.) cases; in 198 (19·8 per cent.) of the cases cavitation was evident on both sides. In comparing the incidence of cavitation in relation to the three major blood groups, it was found that the highest incidence (62·93 per cent.) occurred amongst those in Group O, a lower incidence (54·26 per cent.) in those of Group A, and the lowest incidence (49·39 per cent.) in cases belong-

ing to Group B. The incidence of bilateral cavitation was also found to be highest amongst Group O cases. The small number of Group AB cases precluded any definite conclusion being reached.

Hæmoptysis and Blood Groups

The present investigation was extended to cover any possible relationship between blood groups and hæmoptysis. Attention was attracted to this problem because many of our cases, although having very extensive disease and cavitation, had never experienced bleeding; whilst others, with fibro-infiltrative lesions, had attacks of bleeding which were frequent, recurrent, and often of considerable severity.

In connection with this the various interpretations given to bleeding in pulmonary tuberculosis, a symptom which in some cases constitutes the most prominent feature of the disease, should be briefly mentioned. The most

TABLE IX.—INCIDENCE OF CAVITATION IN RELATION TO BLOOD GROUP DISTRIBUTION AMONGST 1,000 CASES OF PULMONARY TUBERCULOSIS.

Category.	*Total Typed.*	*Blood Group Distribution, Number Typed, and Percentage of each Blood Group.*			
		O.	*A.*	*B.*	*AB.*
No cavitation	417	169 37·06	193 45·73	42 50·60	13 33·33
Unilateral and bilateral cavitation	583	287 61·93	229 54·26	41 49·39	26 66·66
Unilateral cavitation only	385	183 40·14	161 38·15	25 30·12	16 41·02
Bilateral cavitation only	198	104 22·80	68 16·11	16 19·27	10 25·64
All categories	1,000	456	422	83	39

common concept is that bleeding arises from the rupture of an aneurysmal vessel inside an ulcerous process, such as a cavity. Some authors regard hæmoptysis as a manifestation of a hæmorrhagic diathesis (Weill), whilst others have put forward the hypothesis of a special tubercle bacillus or virus.

It is certain, however, that the simple mechanical explanation is insufficient in many cases, and it was therefore interesting to consider the problem in connection with blood group distribution.

In 406 (40·6 per cent.) cases there was a history of hæmoptysis at some time during the course of the disease, and these were classified, according to the severity and frequency of the hæmorrhage, into three grades:

Grade I. Cases with slight staining (198, 48·75 per cent.).
Grade II. Cases with moderate recurrent hæmorrhage (107, 25·37 per cent.).
Grade III. Cases with severe recurring hæmoptyses (101, 23·88 per cent.).

The majority of the cases came under the first category, slight staining being more frequent in patients belonging to Group O, and the least frequent

in those belonging to Group B. The cases in categories II and III (moderate and severe types of hæmoptyses totalling 208 cases) were, however, of greater interest; their blood group distribution was as follows:

Group O, 20·61 per cent.	Group A, 18·48 per cent.
Group B, 28·91 per cent.	Group AB, 30·76 per cent.

It will be seen that the incidence of hæmoptysis was definitely higher in the B and AB groups than in the other two; even more marked are these differences when comparison is limited to the Category III cases.

These observations seemed to indicate that tuberculous patients belonging either to Group B or Group AB were more prone to bleeding, and it was interesting, therefore, to see if the higher incidence may have been due to the presence of cavitation.

Cavitation, and particularly bilateral cavitation, was more frequently found, it may be recalled, amongst patients belonging to Group O, and less frequently among those of Group B. A high incidence of cavitation was also discovered in Group AB patients, but owing to the small number of these cases no conclusions could be drawn.

Consideration of these findings seems to justify the conclusion that there is no interdependence of bleeding and cavitation; on the other hand, blood groups B and AB may constitute a predisposing factor to hæmoptysis. Without further investigation the explanation of these findings is problematical, as patients belonging to these two groups may possibly inherit a degenerative vascular condition which makes them more liable to bleeding.

Blood Groups in Resident Patients

A cross-section of all patients, resident in the various wards of the Papworth Village Settlement on April 30, 1941, was analysed in order to assess their capacity of resistance and response to treatment. These patients, 518 in all, were classified according to their blood groups, the anatomical extent of their lesions and the stage of the disease, and sanatorium grading.

As far as the blood group distribution was concerned, the figures obtained conformed to those already mentioned earlier in this paper.

The relationship between blood groups and the anatomical extent of lesions and stage of the disease is shown in Table XIB. The patients, when classified into the four blood groups, revealed a low percentage of " minimal " cases in Group O, and a high percentage of the same category in groups A and B. On the other hand, in the category of " far advanced " cases there was a definite predominance of Group O against Group A.

With reference to sanatorium grading the patients were divided into three main categories:

Category I. Patients confined to bed, and those getting up for a few hours daily.

Category II. Patients doing light part-time work.

Category III. Patients (Colonists) working seven to eight hours daily.

The findings, as shown in Table XIc, revealed that a greater proportion of patients in category I belonged to blood group O, whereas the blood group distribution of those in categories II and III showed no marked differences.

TABLE X.—HÆMOPTYSIS IN RELATION TO BLOOD GROUP DISTRIBUTION AMONGST 1,000 CASES OF PULMONARY TUBERCULOSIS

(*a*) *Incidence of Hæmoptysis in* 1,000 *Cases of Pulmonary Tuberculosis.*

Incidence of Hæmoptysis.	*No Incidence of Hæmoptysis.*
406	594

(*b*) *Cases with an Incidence of Hæmoptysis Classified into Three Grades.*

Grade I. Slight Staining.	*Grade II. Moderate Recurring Hæmorrhage.*	*Grade III. Severe Recurring Hæmoptysis.*
198 48·76	107 26·35	101 24·87

(*c*) *Hæmoptysis Grades I, II and III, Classified according to Blood Group Distribution.*

Classification.	*Total Typed.*	*Blood Group Distribution, Number Typed, and Percentage of each Blood Group.*			
		O.	*A.*	*B.*	*AB.*
Grade I	198	99 21·71	79 18·72	12 14·45	8 20·61
Grade II	107	53 11·62	40 9·47	9 10·84	5 12·82
Grade III	101	41 8·99	38 9·00	15 18·07	7 17·94
Grades I, II and III	406	193 42·32	157 37·20	36 43·37	20 51·22
Grades II and III	208	94 20·61	78 18·48	24 28·91	12 30·76

(*d*) *Comparison of Incidence of Hæmoptysis in Grades II and III, with Incidence of Cavitation.*

Classification.	*Total Typed.*	*Blood Group Distribution, Number Typed, and Percentage of each Blood Group.*			
		O.	*A.*	*B.*	*AB.*
Hæmoptysis: Grades II and III	208	94 20·61	78 18·48	24 28·91	12 30·76
Cavitation: Unilateral and bilateral	583	287 62·93	229 54·26	41 49·39	26 66·66

With regard to the clinical progress of the patients, the obtaining of information in this respect presented, for several reasons, considerable technical difficulties, one reason being that many of the patients stayed too short a period at the sanatorium: another, that the cases under observation were of a varied

clinical type and at various stages of the disease, thus requiring different methods of treatment. Therefore, although attempted, a satisfactory comparison was almost impossible.

TABLE XI.—CLASSIFICATION OF ALL PATIENTS IN RESIDENCE ON APRIL 30, 1941, ACCORDING TO BLOOD GROUPS, ANATOMICAL EXTENT OF LESIONS AND STAGE OF DISEASE, AND SANATORIUM GRADING

(a) All Patients Resident.

Classification.	*Total Typed.*	*Blood Group Distribution, Number Typed, and Percentage of all Patients Resident.*			
		O.	*A.*	*B.*	*AB.*
All patients resident	518	245 46·71	216 41·71	38 7·33	19 3·66

(b) Anatomical Extent of Lesions and Stage of Disease.

Classification.	*Total Typed.*	*Blood Group Distribution, Number Typed, and Percentage of each Category.*			
		O.	*A.*	*B.*	*AB.*
"Minimal"	73	23 31·50	39 53·42	9 12·32	2 2·76
"Moderate Advanced"	95	39 41·06	46 48·42	7 7·36	3 3·15
"Advanced"	276	131 47·46	116 42·02	17 6·15	12 4·34
"Far Advanced"	74	47 63·51	20 27·02	5 6·75	2 2·70

(c) Sanatorium Grading.

Classification.	*Total Typed.*	*Blood Group Distribution, Number Typed, and Percentage of each Category.*			
		O.	*A.*	*B.*	*AB.*
Category I: Patients confined to bed, or on hours	260	128 49·23	104 40·00	18 6·92	10 3·84
Category II: Patients working part time, 4½ to 6 hours	149	66 44·29	66 44·29	11 7·39	6 4·02
Category III: Colonists working full time, 7 to 8 hours	109	51 46·78	46 42·20	9 8·25	3 2·75

Discharged Patients

Interesting information (see Table XII) was gathered from notes taken on patients discharged during the period of these observations, and some points in this table are worthy of consideration.

It seems remarkable that the incidence of Group O was very low, in

comparison with that of other groups, in the patients discharged under the heading "no further treatment required." It may also be mentioned that the majority of these patients, having received sanatorium treatment, were returning to their normal occupation.

TABLE XII.—BLOOD GROUP DISTRIBUTION IN RELATION TO CLASSIFICATION ON DISCHARGE

(*a*) *At Papworth Village Settlement.*

Classification.	*Total Typed and Percentage of Total Discharged.*	*Blood Group Distribution, Number Typed, and Percentage of each Blood Group based on 560 Cases.*			
		O.	*A.*	*B.*	*AB.*
"No further treatment required"	25 4·46	4 1·58	16 6·58	4 8·69	1 5·55
"Against medical advice"	47 8·39	30 11·85	15 6·17	1 2·17	1 5·55
"Disciplinary reasons"	15 2·67	8 3·16	6 2·46	1 2·17	— —
"Dispensary supervision"	266 47·50	108 42·68	125 51·44	25 54·34	8 44·44
"Transferred to other sanatoria"	147 26·25	72 28·45	58 23·86	10 21·73	7 38·88
"Died at Papworth"	60 10·71	31 12·25	23 9·46	5 10·86	1 5·55
Total discharged	560	253	243	46	18
Blood Group: Percentage of total discharged		45·17	41·60	8·21	3·21

(*b*) *A Comparison between the Ministry of Health Classification on Admission and Discharge of 150 Patients at the Cheshire Joint Sanatorium.*

Ministry of Health Classification.	*Total Typed.*		*Blood Group Distribution.*							
				O.		*A.*		*B.*		*AB.*	
T.B. Minus ..	66		On admission	34		24		7		1	
		50	On discharge		26		18		5		1
T.B. Plus I ..	7		On admission	2		3		1		1	
		6	On discharge		1		3		1		1
T.B. Plus II ..	62		On admission	38		17		6		1	
		65	On discharge		30		24		9		2
T.B. Plus III ..	15		On admission	5		8		1		1	
		29	On discharge		22		7		—		—
All categories ..	150		On admission	79		52		15		4	
		150	On discharge		79		52		15		4

In the "dispensary supervision" category a similar finding emerged, though to a lesser extent, and this, being based on a greater number of cases, is probably more significant.

Finally, a most interesting feature is that relating to discharges due to death (see Table XIII). A method of measuring resistance, a rough one, is that

given by the crude case mortality or fatality rate. This method was used, a calculation being made for each blood group; firstly, on the basis of the total

TABLE XIII.—BLOOD GROUP DISTRIBUTION IN RELATION TO SEX AND AGE GROUPS OF PATIENTS DECEASED DURING THE PERIOD OF OBSERVATIONS.

(*a*) *Incidence of Death in* 1,117 *Cases of Tuberculosis.*

Total.	*Male.*	*Female.*
60	41	19

(*b*) *Incidence According to Age Groups.*

Age Groups.	*Total Typed.*	*Blood Group Distribution, Number Typed, and Percentage of each Age Group Based on* 60 *Cases.*			
		O.	*A.*	*B.*	*AB.*
Under 20	12	8 66·66	4 33·33	— —	— —
20 to 25	12	5 41·66	4 33·33	2 16·66	1 8·33
25 to 30	9	4 44·44	4 44·44	1 11·11	— —
30 to 35	6	4 66·66	2 33·33	— —	— —
35 to 40	5	4 80·00	1 20·00	— —	— —
40 to 45	6	3 50·00	2 33·33	1 16·66	— —
45 to 50	3	1 33·33	1 66·66	— —	— —
50 to 60	5	2 40·00	2 40·00	1 20·00	— —
60 to 70	2	— —	2 100%	— —	— —
All Groups	60	31 51·66	23 38·33	5 8·33	1 1·66

(*c*) *Mortality Rate.*

Classification.	*Total Typed.*	*Blood Group Distribution.*			
		O.	*A.*	*B.*	*AB.*
Total mortality and percentage of total deaths	60	31 51·66	23 38·33	5 8·33	1 1·66
All Cases. Mortality percentage of each Blood Group	1,117	505 6·13	482 4·77	88 5·68	42 2·38
Ratio of mortality in Blood Groups O and A only	54	31 57·40	23 42·59	— —	— —

patients typed (1,117); secondly, on the basis of the discharged patients only; in both cases the period covered was twelve months.

The findings seemed to indicate, at least in the two major blood groups, fairly marked differences, the fatality rate in Group O being 6·13 per cent. and 12·25 per cent., and the corresponding figures for Group A being 4·77 per cent. and 9·46 per cent. respectively.

The total number of cases in each group, it may be recalled, were fairly substantial and approximately equal. Since these figures were compiled twelve further deaths occurred, eight of which belonged to Group O, the remaining four to Group A.

It may also be mentioned that an analysis of the reports on 150 patients discharged from the Cheshire Joint Sanatorium, in a shorter period, revealed the following details which may also be of interest. A comparison of the Ministry of Health classification of these patients, admission with that on discharge, reveals that a far larger proportion, both absolutely and relatively, of these patients belonging to the O group than to the A group were classified in the T.B. Plus III category on discharge. Also, of the seven patients who died six belonged to Group O and only one to Group A.

Hence it may be stated that the fatalities amongst patients belonging to Group O were greater in the same period of time, in number and proportionately, than amongst those belonging to Group A.

Summary and Conclusions

This survey is based on the blood group distribution of tuberculous patients, comprising 1,000 cases of pulmonary and 117 cases of non-pulmonary tuberculosis. The following conclusions have been reached:

I. The blood group distribution of the tuberculous does not substantially differ, if due account is taken of regional variations, from that of the normal population.

II. The incidence of positive family histories is not significantly greater in any one blood group than in the others.

III. Differences of blood group distribution are shown with regard to X-ray characteristics, incidence of cavitation and Ministry of Health classification.

IV. A higher incidence of hæmoptysis, particularly of the severer type, was found amongst patients belonging to blood groups B and AB, an occurrence that was not entirely dependent on the presence of cavitation.

V. A higher proportion of " far advanced " cases was found amongst the patients belonging to Group O than to Group A; the crude mortality rate seems also to be higher among patients belonging to the O than to the A blood group.

VI. Finally, no difference of susceptibility in connection with blood groups could be confirmed, but differences seemed to exist with regard to the course of the disease. The prognosis of patients belonging to Group A seemed more favourable than the prognosis of those belonging to Group O.

I wish to express sincere thanks to Dr. MacCallum, Chief Medical Officer of Papworth, for his encouragement and advice; to my colleagues for their assistance and generous co-operation; to Dr. Cruickshank for the correction of this paper, and to Sister Raby for her help in performing the typing tests. I am also greatly indebted to Dr. P. Edwards, Medical

Superintendent of the Cheshire Joint Sanatorium, for the facilities, advice and encouragement given when carrying out the early part of this investigation, and to Mr. Cutbill, Chief of the Cheshire Joint Sanatorium laboratory.

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CASE REPORT

THORACOPLASTY IN A DIABETIC

By BRIAN C. THOMPSON
From Clare Hall Sanatorium.

PULMONARY tuberculosis in diabetic patients commonly runs an unfavourable course. Though the diabetes may be well controlled, the pulmonary disease, which is often of an acute caseous-pneumonic type, tends to spread progressively even under conditions of absolute rest: tension cavities persist under apparently good artificial pneumothorax, probably because of coincident caseous endobronchitis, and tuberculous empyema frequently follows.

This discouraging picture is the rule; only exceptionally does a diabetic patient show powers of resistance comparable to those seen in favourable cases of non-diabetic phthisis The case to be described is of such a patient, in whom resistance was suggested by radiological clearing of disease and localising fibrosis, supported clinically, biochemically and hæmatologically. We decided

that the pulmonary disease could be approached therapeutically as if diabetes were absent and thoracoplasty was eventually elected. When the time came to plan the operation, however, the diabetic element became important. We knew of no precedent for such an enterprise. Diabetics have probably undergone thoracoplasty before, but if so the fact has escaped our notice. (This absence of reports in the literature is, indeed, the reason for this presentation.) The scheme adopted was therefore evolved from general principles and watchful empiricism. Here is the whole story:

The patient was a married woman, aged 37, known as diabetic for five years. She was originally balanced at North Middlesex Hospital, when a radiograph of her chest was normal. Since then she had been under the care of a private doctor.

Her first pulmonary symptom was hæmoptysis of 1 pint on January 20, 1941, when she was admitted to North Middlesex Hospital urgently. Here she was kept in bed up to being transferred to Clare Hall on April 23, 1941.

On admission she was found to be a well-nourished woman with gross physical signs over the left side of her chest. Her B.S.R. (Westergren) was 23 (1 hour) and 55 (2 hours), her temperature was only occasionally over 99°, and she raised 2 oz. of positive sputum in twenty-four hours. X-ray showed displacement of the heart and mediastinum to the left, dense infiltration throughout the upper two-thirds of the left lung with cavitation and thickened pleura, and scanty infiltration in the right middle zone with a possible cavity. Her urine remained substantially sugar-free on a Lawrence diet of 11 lines with protamine-zinc insulin, units 70 daily.

Collapse therapy being judged desirable, an attempt was made to induce an artificial pneumothorax on the left, but the pleuræ were found to be adherent. A left phrenic crush was performed on May 23, 1941, with the object of aiding relaxation preparatory to major surgery.

Eighteen weeks after admission, during which time she was kept on bed rest, she had gained 20 lb. in weight, her B.S.R. had improved to 8/24, and X-ray on September 8, 1941, showed considerable clearing of the lesions on the right with an increasedly fibrotic character in those on the left, the left hemi-diaphragm being raised and paralysed. The diabetes had also improved so that she was taking 14 lines with only 40 units of PzI. A blood sugar curve showed the following figures:

8. 0 a.m.	0·071 per cent.
8.30 a.m.	0·148 „ „
9. 0 a.m.	0·222 „ „
9.30 a.m.	0·236 „ „
10. 0 a.m.	0·250 „ „

The blood picture was: Hæmoglobin, 78 per cent.; red blood corpuscles, 5,500,000; blood groups, A; white blood corpuscles, 4,960; polymorphs, 69 per cent.; small lymphocytes, 19 per cent.; large lymphs, 0·5 per cent.; large hyalines, 3 per cent.; eosinophiles, 5 per cent.; transitionals, 2·5 per cent.

The sputum was now only a trace but was still T.B. positive, and, in view of the persistent cavitation in the left lung, thoracoplasty was decided upon.

The first stage was performed on September 8, 1941. She had her usual breakfast together with 30 units of soluble insulin and, during the morning, 8 oz. of milk. At 1.30 p.m. she had 1 oz. of glucose with 15 units of insulin, at 2 p.m. omnopon gr. $\frac{1}{3}$ and scopolamine gr. $\frac{1}{150}$ hypodermically, and at 2.40 p.m. morphine gr. $\frac{1}{12}$ intravenously.

At 2.55 p.m. the operation was begun and was concluded at 3.50, the first, second, third and half of the fourth ribs being resected with Semb's apicolysis. Nitrous oxide and oxygen was given continuously together with paravertebral local anæsthetic block. Rectal infusion of 5 per cent. glucose in 1 pint of saline was given during the operation; the patient was conscious on leaving the theatre and was in good condition, her pulse-rate being 100 and her systolic blood pressure 120. Her blood sugar before the operation was 0·08 per cent. and after the operation 0·066 per cent. At 6 p.m. she was given by intravenous drip 900 c.c. of blood followed by 10 oz. of saline containing 1½ oz. of glucose and 30 units of insulin. At 9.30 she was given a pint of rectal saline with 5 per cent. glucose and an hour later morphine gr. ¼ and atropine gr. $\frac{1}{150}$. She passed a quiet night without cough or respiratory distress, mostly sleeping. Urine specimens obtained at four-hourly intervals showed constantly a trace of sugar.

At 6 a.m. of the day following the operation she was given rectally a pint of saline containing 5 per cent. glucose, and 20 units of insulin, and at 8 a.m. her usual breakfast. This she immediately vomited, but was then gradually sat upright and was able at 10 a.m. to drink and retain 8 oz. of milk. She took her normal dinner and from then on her usual 14-line diet, with insulin-soluble units 30 a.m. and 20 p.m. Her evening temperature rose to 100° several times but became normal in eight days.

On October 8, 1941, the second and final stage was performed, more of the fourth rib and lengths of the fifth, sixth, and seventh ribs being removed to produce a graded collapse. The anæsthetic and dietetic technique employed was substantially as for the first stage, and her constitutional upset even less marked, except for a slight degree of paradoxical respiration during the first few days.

She was kept on bed rest for twelve weeks after completion of the thoracoplasty. Her sputum very soon became reduced almost to nil and negative for T.B.

She was discharged on February 28, 1942, on a diet of 16 lines, with a single dose of insulin, soluble units 20 and protamine-zinc units 30. Her sputum was constantly negative, including cultured specimens, except for a single smear on January 29, 1942.

She is to-day alive, well and without symptoms.

The operation was performed by Mr. T. Holmes Sellors. Dr. Alice Rose was the anæsthetist and Dr. F. A. H. Simmonds, Medical Superintendent of Clare Hall, to whom acknowledgment is due for permission to publish the case, was closely concerned with its clinical management.

JOINT TUBERCULOSIS COUNCIL

A MEETING of the Joint Council was held at the London School of Hygiene and Tropical Medicine on Saturday, February 20, 1943, at 10.0 a.m.

The following were present: Drs. G. Lissant Cox, W. H. Dickinson, Peter W. Edwards, N. England, A. P. Ford, L. E. Houghton, G. Jessel, V. Emrys Jones, R. L. Midgley, Mr. E. H. Roberts, Drs. N. Lloyd Rusby, A. Sandison, Norman F. Smith, D. P. Sutherland, N. Tattersall, H. G. Trayer, E. Ward, James Watt (Chairman) and the Hon. Secretary.

Apologies for absence were received from Drs. H. J. Burrows, J. Ferguson

A. S. Hall, F. R. G. Heaf, V. Ryan, Cochrane Shanks, and Prof. W. Tytler.

The Chairman referred to the great loss which the Council had sustained by the deaths of Dr. Dan Powell and Dr. G. B. Dixon. Dr. Dixon had been a more recent member of the Council, but the wisdom he brought to bear on its deliberations from his long experience in the City of Birmingham had been invaluable. Dr. Dan Powell had for many years been an active member of the Council and was, at the time of his death, the Chairman. He had endeared himself not only to members of the Council but to every member of his great family in Wales. It was resolved that the deep obligation which the Council owed to Dr. Powell be recorded in the minutes, and the Secretary was further instructed to convey the sympathy of the Council to the families of Dr. Dixon and Dr. Powell.

Correspondence.—(*a*) Dr. Munro (representative of the Scottish Tuberculosis Society) forwarded his resignation, which was accepted with regret. The circumstances which compelled Dr. Munro to resign were given in the correspondence. The Hon. Secretary reported that the new nominee from the Scottish Society had not yet been submitted.

(*b*) Following correspondence with Prof. Tytler, it was agreed that he be invited to submit a memorandum on the rôle of Promin in the treatment of tuberculosis.

(*c*) A letter from the Faculty of Radiologists appointing Dr. S. Cochrane Shanks vice Major Peter Kerley to the Council was received.

(*d*) Dr. Norman Smith, Ministry of Health Observer, submitted information on the use of vitamin K in tuberculosis. " In brief, if there is definite evidence of a denciency of prothrombin it is advisable to exhibit vitamin K. In the absence of such evidence its administration is of no value."

(*e*) A letter from the Essex County Medical Officer of Health was read asking whether " a properly conducted enquiry could be made into the deaths from tuberculosis, with a view to ascertaining information which might reveal that certain steps had not been taken by medical practitioners and others to ensure that the patient had every opportunity of receiving appropriate treatment for the tuberculous condition." The Hon. Secretary was instructed to correspond further with Dr. Bullough on the subject with a view to clarifying certain doubtful points in the suggested enquiry.

(*f*) Dr. A. P. Ford amplified verbally the contents of a letter he had sent drawing attention to the entrance of certain cases of tuberculosis in industry. The matter was referred to the discussion resulting from the " Tuberculosis in War-time " Report.

Election of Officers for 1943.—The following, having been duly nominated, were elected unanimously: Chairman, Dr. James Watt; Vice-Chairmen, Drs. D. P. Sutherland and N. Tattersall; Hon. Treasurer, Dr. G. Jessel; Hon. Auditor, Dr. D. P. Sutherland; Hon. Secretary, Dr. J. B. McDougall.

A Résumé of the Work of the Joint Tuberculosis Council—The Hon. Secretary formally presented a résumé of the Council's work from its inception. He welcomed one or two suggestions from members of the Council and made no claim that the résumé was complete in every detail. It was resolved that, with the incorporation of the omissions to which attention had been drawn, the résumé be printed and circulated to Local Authorities, the Medical Press, the Ministries, to hospitals and constituent bodies. It was estimated that 500 copies would be necessary.

Annual Accounts.—The Hon. Treasurer (Dr. G. Jessel) presented the Statement of the Annual Accounts which showed a balance of £52 17s. on deposit

and of £61 2s. on current account—a total of £113 19s. He referred particularly to the great assistance which the Council had had from the Ministry of Health grant and to the satisfactory income from the sale of publications. Dr. Sutherland (Hon. Auditor) paid tribute to the manner in which the accounts had been kept, and it was resolved that the accounts be adopted, with thanks to the Hon. Treasurer.

Mass Radiology and Treatment Allowances for the Tuberculous—Mass Radiology.—Dr. Jessel (Convener of Radiology Committee) dealt with the present position of mass radiology as outlined in the final draft circular of the Ministry of Health. He paid tribute to the wisdom, skill, and understanding of the Chairman of the Committee, Mr. Lindsay, who had been appointed by the Ministry. There had been the happiest relationship throughout the negotiations with the radiologists and it was satisfactory to know that the original report of the Joint Tuberculosis Council on this subject had to a large extent been accepted. The report about to be circulated to Local Authorities was a technical report, and dealt especially with apparatus, teams, and administrative problems. Some difference of opinion had arisen in regard to the personnel to view the films, but this difficulty had been resolved by the suggestion that viewing of the films should be done by one person. A standard classification had been evolved.

In the brief discussion which followed a full measure of support was given by the Council to the findings of the Committee which had dealt with the subject.

Treatment Allowances.—This, the second section of the proposed circular to Local Authorities, was outlined by the Chairman at some length. He gave the Council a comprehensive picture of the magnitude and importance of the problem alike to the patient suffering from pulmonary tuberculosis and to the tuberculosis officer. The crucial problem which had still to be settled was " For what forms of tuberculosis shall these allowances be paid?"

The Hon. Secretary elaborated the Chairman's remarks and gave the sequence of events which had led up to the subject being referred to the Joint Tuberculosis Council The advantages of the scheme had to be considered alongside the potentialities for abuse of many of its privileges. Certain anomalies—*e.g.*, with regard to Public Assistance allowances—must be clarified. The Hon. Secretary pointed out that, with reference to the complete circular, it would not be possible for members to discuss the detailed proposals, but, as the Ministry of Health were desirous of obtaining the Council's views, the circular could be circulated to members, who would have an opportunity of studying it and of submitting their views to the Hon. Secretary prior to a visit to the Ministry of a Committee of the Council at an early date.

A general discussion followed, largely in the form of question and answer, and it was suggested by Dr. Sandison that treatment allowances should be paid if the patient is recommended by the Tuberculosis Officer for " a period of treatment specifically prescribed by the Tuberculosis Officer, with the aim and reasonable anticipation of restoration of working capacity." Dr. Sutherland suggested that to this formula should be added the words " and to cases in whom restoration of working capacity is unlikely but who carry out the requirements of the Tuberculosis Officer necessary to prevent the spread of infection."

On all sides it was agreed that a definition of " Treatment " for the purpose implied in the circular would be difficult to formulate with a precision which would be foolproof in every contingency, but the following resolutions were carried unanimously:

(1) That the deputation to meet Mr. Lindsay, and if possible Sir Wilson Jameson, at the Ministry of Health at 3 p.m. on Tuesday, March 2, 1943, be the Officers of the Council together with Dr. V. Emrys Jones (W.N.M.A.).

(2) That the Hon. Secretary circulate a copy of the Ministry's report to all members of the Council inviting them to forward their views to him prior to the deputation on March 2, 1943.

Tuberculosis in War-time.—The Chairman presented the memorandum which had been previously circulated. The memorandum was considered in paragraphs and certain alterations were suggested. It was resolved that copies (when finally correct) be sent to the Ministries concerned and to constituent societies.

Tuberculosis Nursing.—Prior to Dr. Trayer (Convener) presenting his report (previously circulated) letters were read from Dr. Heaf (protesting against much in the report and dissociating himself from it on the grounds that in its present form " it will hinder rather than help the progress of nursing in this country "). He stressed the number of E.M.S. units " now able to obtain excellent results in thoracic surgery on tuberculous patients without having staffs trained in sanatoria, proving that exclusiveness of this work is largely a myth." Dr. Heaf also referred to a point made in another letter received from Dr. Esther Carling—*i.e.*, the lack of financial arrangements to cover the risk of infection and compensation if breakdown occurs.

Dr. Trayer said that the report was a combined one—between the Tuberculosis Association and the Joint Tuberculosis Council Committee on Tuberculosis Nursing for submission to their respective Councils—and he felt it should be regarded as fully representative. A number of minor alterations were agreed to by the Council with the concurrence of the Tuberculosis Association's representatives, but stalemate had resulted when an attempt had been made to arrive at a " title " for the tuberculosis nurse. The Council could not help.

It was resolved that the report, with corrections as resubmitted to the Council, be published in the Medical and Nursing Press and circulated to the Ministry of Health and constituent societies.

Post-Graduate Classes.—The Hon. Secretary, on behalf of Dr. Heaf, Convener of Post-Graduate Classes, reported that a class would be held at the City of London Hospital in the middle of March. Further details would be circulated in the usual way.

Co-operation with other Tuberculosis Organisations.—The Chairman informed the Council that there was nothing to report.

Nutrition Committee.—Dr. D. P. Sutherland agreed to assume Convenership of the Nutrition Committee vice Dr. Munro (resigned).

Committee on Nutrition : Tomlinson Report.—Consideration of these subjects was deferred to the next meeting of the Council.

Date and Place of Next Meeting.—London School of Hygiene and Tropical Medicine, Saturday, May 22, 1943.

NURSES' SALARIES COMMITTEE

First Report to Minister of Health

The Nurses' Salaries Committee, consisting of panels representing employers' organisations and nurses' organisations, under the chairmanship of Lord Rushcliffe, were appointed by the Minister of Health in November 1941

to draw up agreed scales of salaries and emoluments for nurses employed in England and Wales in hospitals and in the public health services (including district nursing).

The Committee's first report (presented to Parliament by the Minister of Health as a Command Paper*) deals only with female hospital nurses. Further reports are to be issued on other matters within the Committee's terms of reference; and a similar committee, also under the chairmanship of Lord Rushcliffe, are considering midwives' salaries.

The Committee recommend, for the first time in the history of the nursing profession, national salary scales covering every grade of nursing staff in every type of hospital (except mental institutions, to which nationally negotiated scales already apply). On these scales the Committee comment that while the salaries of nurses have materially improved since the report of the Athlone Committee (December 1938), " the recommendations which we make show that we are of opinion that a further substantial improvement is necessary. It is true that scales of salary at the present time differ considerably in different hospitals, but *the adoption of our proposals will mean a considerable improvement in the financial position of the great majority of female hospital nurses in the country.*"

In addition, the Committee present proposals on hours of work, uniform, night duty, holidays with pay, a weekly day off duty, and sick pay.

They recommend that their scales of salaries and emoluments, and the proposals on conditions of service so far as they are applicable, should come into operation on April 1, 1943. (See paras. 54-57.)

Salaries—The report quotes the view of the Athlone Committee that " it is fundamentally wrong to attempt to attract recruits of the proper type by offering initial salaries which are high by comparison with those offered to the trained nurse. The entrant to the profession who intends to make a success of her work and remain a nurse is naturally more interested in her prospects than in the immediate reward."

The Rushcliffe Committee state: " We regard it as a matter of the first importance that, notwithstanding the many other demands on woman-power at the present time, an increased flow of student nurses into hospitals should be both encouraged and effected. We have had to bear in mind the fact that the student nurse should be regarded primarily as a student, who is receiving a valuable training, with tuition from medical staff as well as senior nursing staff, although at the same time she is helping to staff her hospital. In other professions it is customary for a student to pay fees for training; the student nurse not only receives hers free, but in addition is paid a salary and provided with her emoluments. What is in our view chiefly required as a stimulus to recruiting is that the prospects of the nurse after training, in senior as well as junior posts, should be equitable and attractive."

On " *undesirable competition for staff between different hospitals,*" the Committee comment: " The national adoption of the scales we have drawn up will bring such competition to an end."

Recommended Scales.—In addition to recommending salary scales for each grade of nursing staff in every type of hospital, the Committee have fixed, for each category of nurse, what is considered to be a reasonable valuation of the emoluments (board, residence, personal laundry and the use and laundering of uniform) in terms of cash; this amount to be the standardised value of the emoluments for superannuation purposes.

* Cmd. 6424. H.M. Stationery Office, York House, Kingsway, W.C.2, price 9d., post free 11d.

The salary scales are set out in detail in the report. Examples applying to general hospitals are:

	Scales of Annual Salary.	*Total Value of Salary and Emoluments.*
Student Nurse	First year, £40; second, £45; third, £50; fourth year (before State registration), £60; fourth, after State Registration (if on four years contract), £70	£115-£145
Staff Nurse (on general part of State Register)	£100 rising by £5 a year to £140	£190-£230
Ward Sister	£130, rising by £10 a year to £180; with one additional increment of £20 after ten years' service as ward sister	£230-£300
Qualified Senior Sister Tutor (in charge of one or more others)	£260 rising by £15 a year to £350	£380-£470

For nursing staff up to and including sisters in sanatoria and tuberculosis hospitals, higher rates of pay are proposed. For example, student nurse, £45 first year, £50 second year; ward sisters, staff nurses and assistant nurses, £10 a year more than the rates for general hospitals. The Report recommends these higher scales for sanatoria and tuberculosis hospitals " owing to the special difficulty of staffing that prevails."

In the case of matrons and assistant matrons, detailed scales are proposed according to the type and size of the hospital. In a hospital with 500 or more beds approved by the General Nursing Council of England and Wales for complete training in general nursing, sick children's nursing or fever nursing, the matron's salary should range from £450 to £700 (total value of salary and emoluments, £650 to £900).

In proposing that these scales should be brought into operation by employing authorities on April 1, 1943, the Committee recommend that nurses newly appointed, or promoted to a higher grade, on or after that date, should have the recommendations applied to them as a whole. Nurses in the service of hospital authorities on April 1 should have the new salary scales applied to them in two instalments—the first on April 1, 1943, and the second (which will bring them to their appropriate point on the new scale) on April 1, 1944. Any nurse who wishes may, however, remain on the existing sale for her grade, though on promotion the recommendations will apply. (This is to safeguard the position of any nurses enjoying more favourable scales at present.)

Superannuation.—The Committee, who are to deal with Superannuation in a later report, state that, like the Athlone Committee, they regard it as important that arrangements should be made for complete mobility of transfer between the two existing types of superannuation scheme (para. 5).

Hours of Work : Holidays.—The Report also makes recommendations on conditions of service which have a direct bearing on salary. On hours of work the Committee say:

" We feel that nursing is a profession which does not allow of regimentation on a strict basis of hours to be worked, but the standard on which the salaries scale agreed by the Committee is based is a 96-hour fortnight, day or night; and we recommend that, as soon as conditions permit, this should be brought into national operation for the general body of nurses (except those in supervisory positions) at a date to be determined by the Minister of Health, having regard to the availability of staff and subject always to the requirements of the service.

" In cases of epidemic or emergency when exceptional demands are made

upon the staff, arrangements should subsequently be made for additional off-duty time. For student nurses, the 96-hour fortnight should be inclusive of lectures and tutorial classes, which so far as possible should not be held towards the end of duty time.

"We recommend that all grades of nursing staff, including student nurses, should have at least one complete day off duty a week; and that they should have 28 days holiday with pay each leave year."

Other recommendations include:

Night Duty.—"We are of opinion that the appointment of nursing staff for permanent night duty only is generally undesirable. We recommend that the maximum continuous periods of night duty should be six months for sisters and staff nurses, and three months for student nurses. We consider also that night superintendents should not be engaged in continuous night duty for longer than two years."

Training.—The practice adopted by some hospital authorities of charging fees to student nurses on their entry for training in a hospital or a preliminary training school should be discontinued (para 43).

The General Nursing Council should regularise the arrangements for the training of sister tutors (para. 17). An educational grant should be made by the Ministry of Health to enable suitable nurses, who otherwise could not afford it, to train for qualification as sister tutors (para. 18).

Owing to the extended range and increased specialisation of nursing work in the treatment of tuberculosis and certain other respiratory diseases, the General Nursing Council should institute a supplementary part of the State Register for such nurses, though use of the term "tuberculosis" in the title should if possible be avoided; and sanatoria should be encouraged to become training schools for such a part of the Register (para. 41).

Sanatoria.—The authorities of sanatoria and tuberculosis hospitals should arrange for all nursing staff other than matrons or assistant matrons to have the privilege of free travel twice a week to the nearest centre of population.

Sick Pay.—Proposals for minimum periods of sick pay are set out in para. 53.

OBITUARIES

DAN ARTHUR POWELL

THE untimely death of Dr. Dan Powell in December last at the age of fifty-eight was a sad loss not only to the Welsh National Memorial Association, of which he had been the Principal Medical Officer since 1927, but also to all who knew him.

Powell was born at Bedlinog, Glamorganshire, and received his early education at Pergan School, from which he went to University College, Cardiff and Charing Cross Hospital. After qualifying in 1908, he took the London M.B., B.S., the following year with Honours in Medicine, and the M.D. soon after that. Resident appointments at Charing Cross Hospital followed, and he was then appointed one of the first Tuberculosis Physicians of the Association in 1912, serving there until May 1915, when he joined the R.A.M.C. On returning, he resumed his work for the Association in North Wales, and in 1921 became Medical Superintendent of the North Wales Sanatorium, Denbigh. In 1926 he was appointed Deputy Principal Medical Officer to the Association, and a year later became Principal Medical Officer.

Powell was that rare combination, a sound clinician and a good administrator. His early training gave him an interest in the clinical side of tuberculosis work which he never lost, and though in later years his work was so largely administrative, he always kept in close touch with clinical problems. His wise foresight and direction was largely responsible for establishing the Sully Tuberculosis Hospital, and for the many extended facilities for the treatment of tuberculosis which have taken shape in Wales during the last fifteen years.

Powell gave freely of his time and energies in many fields. He was Chairman of The Joint Tuberculosis Council, a member of the Standing Advisory Committee on Tuberculosis, of the M.R.C. Committee on Industrial Pulmonary Disease and of the Prophit Bequest Committee of the Royal College of Physicians. In every field where his interests extended he will be sadly missed for many a day.

C. H.

G. B. DIXON

THE death of Dr. G. B. Dixon has removed one of the most distinguished of the now diminishing band of men who took up duty as Tuberculosis Officers on the initiation of the National Health Insurance Act just over thirty years ago.

Godfrey Brookes Dixon was a Cumbrian by birth and received his medical education at Charing Cross Hospital, where as a student he won the Gold Medal in Medicine. Under the influence of Dr. Mitchell Bruce, to whom he was House Physician, his interest was directed to tuberculosis early in his career, and soon after qualifying in the year 1901 he spent the best part of two years at Davos in Switzerland studying the treatment of tuberculous patients there. He then became Assistant Medical Officer and later Superintendent of the Walton Infirmary, Liverpool, where he was one of the first to institute the open-air treatment of patients suffering from pulmonary tuberculosis in a Poor Law Infirmary. Later he was for a time Assistant Medical Officer at the Vale of Clwyd Sanatorium. Subsequently he spent five years in general practice as assistant to his cousin, Dr. J. H. Salter, of Tolleshunt D'Arcy in Essex.

The turning point in his career came in 1910, when at the age of thirty-three, having had to retire from general practice following an attack of pneumonia, he was appointed Medical Superintendent of the Birmingham Municipal Sanatorium at Yardley Road, then on the outskirts of the city. In 1912 he intended to apply for the post of Superintendent of the Brompton Hospital Sanatorium at Frimley, when Dr. Marcus Patterson left Frimley for Wales, but was dissuaded from doing so by Dr. John Robertson, the Medical Officer of Health of Birmingham, who recognised his great ability and insisted on retaining his services in Birmingham, and he was appointed Tuberculosis Officer for the City of Birmingham. From small beginnings the tuberculosis service of the city became built up around his person and under his guidance, and for thirty years he performed the double duty of Superintendent of a sanatorium of over three hundred beds and Chief Tuberculosis Officer to a city of one million population, with the supervision of three other sanatoria.

Dixon was extremely painstaking, and possessed a real flair for organisation. Though never averse from new ideas, he liked first to assure himself that they were sound; he distrusted those whom he called "wild men," who were disinclined to look before leaping. His advice on administrative problems was frequently sought by Tuberculosis Officers and Medical Officers of Health of other localities as well as by the Ministry of Health. In later years it gave him much grati-

fication to be elected to serve on the Council of the National Association for the Prevention of Tuberculosis and on the Joint Tuberculosis Council, and he took great interest in this work.

Dixon was a man who possessed a high sense of duty; he never spared himself in doing what his conscience dictated; no community could have had a more faithful public servant. Though always a stubborn fighter for what he believed to be right, he was an extremely sensitive man, and was apt to feel acutely things that might not have affected one less sensitive. This sensitivity undoubtedly increased the mental and physical strain of his work in one who never enjoyed robust health. His chief delight was centred in his home; he had an appreciation of old furniture and silver, and a good knowledge of the Birmingham School of Painters, some examples of whose work he possessed. Our sympathy goes out to his wife and daughter, who together nursed him devotedly throughout his long and painful final illness. He was a man of outstanding personality and for those who knew him his passing leaves a gap that will be hard to fill.

J. R. T.

CORRESPONDENCE

SIR,

Can we view the modern trend in the world of tuberculosis without certain grave misgivings? The obliteration of cavities has lately become such a successful proposition, and both the theory and practice of cavity-obliteration present such fascinating avenues for exploration that the tendency among our more progressive workers is to become cavity-minded and to ignore the problems of the disease in any of its other manifestations. I am not belittling the splendid work and rapid strides made by our thoracic surgeons, but rather regard the situation as analogous to one where abdominal surgeons might be devising superb operations for excising or short-circuiting peptic ulcers, and medicine, dazzled by their glamour, forgot the possibility of treating pre-ulcerative dyspepsias.

Am I utterly heterodox when I submit that a cavity is but an incident in the course of the disease? It is not present in the earlier stages; and what kills the patient in the last stages is not the granuloma-lined hole but the massive spreading infiltration in lung-tissue previously healthy. Is it too fantastic to comment upon an X-ray photograph showing excavation in one lung and infiltration in the other by saying: "Where there is infiltration the battle rages Panzer-fashion, and there are no organised defences: *here is where help is needed.* Excavation represents the development of trench-warfare: the defences are organised and the enemy encircled. The cavernous lung is looking after itself well. It may have had to fall back on scorched earth policy, but it has the situation in hand. It can wait, if need be"?

If the foregoing is not all nonsense—and I hope someone will point it out if it is—why is the tendency to make a bee-line for cavities as if they were an immediate danger rather than a Damoclean menace to the patient? As a long-term policy I agree that it is a good thing to relax your cavity-bearing zone surgically, to narrow the perimeter of the defences, to cut off the invaders from their supplies, and, if indicated, even to suck them out through a Monaldi tube: this rounding-up of potential fifth-columnists may very well diminish the threat of disaffection in other parts of the lungs via inhalation, blood- or lymphatic-spread. And that is what our surgeons are doing so brilliantly,

reaping their reward radiologically and by the reduction of sputum; which in itself is admittedly an important contribution to public health.

Their arguments for doing this are sound—as far as they go; but I must protest that mechanical interference is not the whole story of therapeutics in tuberculosis. And yet a layman—or even a medical man—picking up any journal or attending any conference might easily gain the impression that the obliteration of cavities was the one and only problem in tuberculosis.

Rosa Dartle-wise I ask, What is the correct treatment of non-cavernous pulmonary tuberculosis? How long is it since any work was done or published comparing the results of relaxation-therapy in such cases with those where treatment was on conservative lines?

Much that has been written in the past and is accepted today as gospel about rest and exercise, diet, climate, tuberculin, etc., would appear to stand unchallenged because nobody has bothered to challenge it. Is it not time that physicians were stimulated and encouraged to overhaul those classical but empirical observations now that the effects of therapeutic measures can be assessed by radiology and blood sedimentation? Is not the whole world of tuberculosis in urgent need of reminding that tuberculosis is a generalised disease, affecting not only a radiologically missing piece of lung but the patient as a whole, from his metabolism to his very mentality?

Finally, how is the student of today going to prescribe tomorrow for the preclinical case diagnosed by mass-radiology? What is he being taught? To wait until a cavity shows on the X-ray, and then call in a surgeon—quick?

Yours, etc.,

The Mundesley Sanatorium. George Day.

NOTICES

THE BRITISH LEGION AND TUBERCULOSIS TREATMENT

Acquisition of Nayland Sanatorium

For some time it has been felt that the facilities available for the treatment of tuberculosis in males at the British Legion Village, Preston Hall, and at Douglas House, Bournemouth, should be extended to females, especially to those women who are now being discharged from the Services.

The Council of Management of Preston Hall have, therefore, concluded arrangements with the authorities of the former East Anglian Sanatorium near Colchester to take over that Institution, which will in future be known as Nayland Hall, for the provision of modern treatment of tuberculosis in females. It is proposed to develop Occupational Therapy and Training in industrial pursuits on the same lines as have been followed at Preston Hall and Douglas House, and to link up the industrial activities of all three Institutions for the benefit of the patients in each.

The Sanatorium at Nayland has been well known to tuberculosis workers for many years as the Institution which was pioneered by the late Dr. Jane Walker. The administration of Nayland Hall in the future will be undertaken primarily from Preston Hall, under the direction of Dr. J. B. McDougall. The British Legion have decided to embark on extensive alterations to certain sections of the property at Nayland as and when labour and material become available, but as from May 1 next the direction of the Institution will pass to the British Legion.

First Tuberculosis Hospital for Children in Palestine

The first tuberculosis hospital for children in Palestine was opened recently with a formal ceremony. It is situated in Mekor Hain, a suburb of Jerusalem. In the same suburb there is in existence a Sanatorium of the Anti-Tuberculosis League, where some 100 adult tubercular patients are undergoing treatment. The new hospital is fitted with 30 beds; so far it has only 10 young patients as the budget is not yet assured.

A new surgery department annex of the Beilinson Hospital has just been opened in Petak Tikwath. The new annex contains 30 beds. The Beilinson Hospital is owned by the Jewish Labour Movement in Palestine. It is administered by the Workers Sick Fund of the General Jewish Labour Federation. The new annex is housed in a former private hospital which has now been taken over by the Workers Sick Fund of the Labour Movement.

REVIEWS OF BOOKS

X-Ray Atlas of Silicosis. By Dr. Arthur Amor. Bristol: John Wright and Sons, Ltd. 2nd Edit., 1942. Price 30s.

As Sir Wilson Jameson points out in his preface to this book, silicosis, although one of the oldest and most important of occupational diseases, is still imperfectly understood by the great majority, in spite of the recent increased attention to industrial medicine. Early diagnosis is of course radiological, and Dr. Amor has endeavoured to supply the real need for a short book of X-ray diagnosis. As far as it is possible to impart the technique of correct interpretation of the radiological appearances from textbook X-ray reproductions, he has certainly succeeded. His book will be of special value to colliery medical officers.

The atlas begins with a well-written and concise introduction dealing with the ætiology, pathology and clinical features of silicosis and silico-tuberculosis, and a preliminary description of radiological appearances in the chest, normal and pathological. It might have been well to mention here for the benefit of the less expert the superficial resemblance between the reticulation of the ante-primary stage and the exaggeration of broncho-vascular markings and foliation of terminal bronchi seen in the catarrhal lungs of chronic bronchitics with emphysema, in bilateral bronchiectasis or more rarely bronchiolectasis. Vascular congestion, too, with or without cardiac enlargement may simulate reticulation. The possible confusion of residual neohydriol might have been included.

The main part of the book follows, and consists of a series of X-ray reproductions of silicosis and silico-tuberculosis as it may occur in the various occupations. The selection of pictures from the many different silicosis-producing industries is of real value here. The section on coal mining has been revised since the first edition in the light of the recent M.R.C. report. The reproductions are on the whole of a high standard, but plates VII and VIII and LI, LIII, LV in particular demonstrate the impossibility of successful reproduction of minimal deviation from the normal. An inset enlargement of a portion of the lung field might have achieved this. Each picture is accompanied by a short case history with a French translation.

The final section deals very briefly with differential diagnosis. Chronic miliary tuberculosis, carcinomatosis, and asbestosis are well illustrated. A

picture of bilateral tuberculous infiltration with excavation is shown, but no mention is made of broncho-pneumonic disease, tuberculous or otherwise, nor of focal disseminated pneumonia, all of which might cause considerably more confusion than the more usual fibro-caseous disease. Boeck's sarcoidosis, too, is omitted, and the lymphogenous type of carcinomatosis, although baratosis is included.

Altogether a book of definite specialised value, and elegantly presented. The price of thirty shillings is by no means unreasonable.

Tuberculosis in Childhood. By DOROTHY S. PRICE, M.D. Bristol: John Wright and Sons, Ltd., 1942. Price 17s. 6d.

The fact that so many people suffer no ill-effects from primary infection by the tubercle bacillus is no excuse for viewing primary tuberculous lesions with complacency. Tuberculosis is an ever-present problem in the field of pediatrics and, until recently, its study has included chiefly the more definite clinical forms such as tuberculosis of bones and joints, abdominal tuberculosis, cervical adenitis, gross pulmonary tuberculosis and tuberculous meningitis; the primary lesions, their etiology, and the course of the disease as a whole have not been given the same prominence. Publications on these and other problems of childhood tuberculosis are to be found scattered throughout the medical literature of the world, but we are indebted to the author of "Tuberculosis in Childhood" for condensing the matter into a remarkably concise and readable little volume which she describes as "a brief practical guide to the diagnosis and treatment of tuberculosis in children." The fact that the bibliography at the end of the book fills eight pages is a tribute to the work which this condensation has involved.

The author has been able to draw from a large fund of clinical experience at the children's hospitals in Dublin for the material for her book. She covers the entire ground of tuberculosis in childhood and fully illustrates the text with X-ray pictures, the reproduction of which, however, does not always do justice to the material which they illustrate. Special emphasis is laid on primary tuberculosis of the lung. Although there are those who would not go so far as Miss Price in her view that "it is advisable to remove all young children to hospital or preventorium for the first three months after development of a primary infection," it is of definite value that she has stressed the need for adequate treatment of the condition. Special forms of treatment described include inoculation with B.C.G. vaccine—a treatment of which the author has had personal experience. Full and detailed descriptions are given of the different types of tuberculin tests, and their relative merits are discussed. The chapters on Extra-pulmonary Tuberculosis and Tuberculous Orthopædic Lesions have been written in collaboration with H. F. MacAuley.

This cannot be regarded as a textbook, since it includes much controversial matter, especially in the passages dealing with the etiology and the classification of tuberculous lesions. This personal outlook, however, although it may lead to premature crystallisation of some, as yet, unproved theories, adds greatly to the interest and to the aliveness which are characteristic of the book throughout. The theoretical aspects might perhaps with advantage have been balanced with definite facts, such as detailed descriptions of pathological processes, which are conspicuously absent from the book.

This should prove to be a most valuable guide to those who are faced with the ever-increasing problems of diagnosis, treatment and control of tuberculosis in children.